

**PILOT SOIL VAPOR EXTRACTION SYSTEM WORK PLAN
BOISE, IDAHO**

VAN WATERS & ROGERS INC.

January 24, 1992

EXHIBIT 4



**PILOT SOIL VAPOR EXTRACTION SYSTEM WORK PLAN
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**PILOT SOIL VAPOR EXTRACTION WORK PLAN
BOISE, IDAHO**

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1.0 INTRODUCTION

From approximately 1973 to 1983, VW&R operated a small distribution facility from a portion of a warehouse located on Friedly Drive, Boise, Idaho. Nielsen Transfer & Storage Co. (NT&S) also occupied a portion of the warehouse throughout the term of the VW&R lease. In approximately 1987 or 1988, the warehouse was removed from the site. Today, a Pier 1 Imports store occupies the general area where the warehouse, partially occupied by VW&R, was located. The current address of the Pier 1 Imports store is 140 Milwaukee Avenue, Boise, Idaho (Plate 1). The Pilot Vapor Extraction System Workplan was developed by Van Waters & Rogers Inc. (VW&R) to evaluate vapor extraction technology to remediate soil contamination in the area around the former VW&R facility.

2.0 BACKGROUND

2.1 Site Description and History

A Pier 1 Imports store and large paved parking area currently occupy the site (Plate 2). From approximately 1973 through 1983, VW&R operated a small chemical distribution facility at the Pier 1 site from a warehouse also occupied by NT&S. The property was apparently owned by a number of people during VW&R's tenancy, including NT&S, Nielsen Warehousing Co., Monteford Brooks, and Shirley O'Rielly (n/k/a Shirley O'Rielly Crowe). VW&R reportedly stored perchloroethylene (PCE) in an aboveground tank at this facility. Plate 2 shows the approximate location of the former PCE tank as determined through review of historical aerial photographs. It is understood that the warehouse occupied by VW&R was taken down in late 1987 or early 1988.

Beginning in approximately 1987, the area west and north of the site has been developed. Projects include the Boise Towne Square Mall, a portion of a Walla Shopping Center Associates (Walla) development, other retail stores, light commercial buildings, and high density housing.

2.2 Site Hydrogeology

The shallow geology in the vicinity consists of terrace gravels 50 to 150 feet thick that have been reworked and deposited by the Boise River. The terrace gravels are generally overlain by 2 to 4 feet of engineered fill. Boring logs from two monitoring wells in the immediate vicinity of the site indicate that approximately 4 to 4.5 feet of fill are underlain by stiff clay and silt to an approximate depth of 8 to 8.5 feet. Sand and gravel underlie the clay and silt to a depth of at least 24 feet (the total depth of the borings).

A shallow aquifer in the site vicinity is present under water table conditions at an approximate depth of 8 to 14 feet below ground surface (bgs). Localized groundwater recharge and discharge vary seasonally. Recharge generally occurs from the Ridenbaugh Canal during the irrigation season between April and October. However, localized groundwater discharge to the irrigation canals and sloughs has been observed in the area. Although the water table level and flow direction may fluctuate with the irrigation season, the predominant regional flow direction in this shallow aquifer is to the northwest.

3.0 FIELD INVESTIGATIONS

VW&R and its consultants conducted a soil gas survey in the vicinity of the former VW&R facility; collected and analyzed groundwater samples from two monitoring wells previously installed by the State of Idaho, Department of Health and Welfare, Division of Environmental Quality (DEQ); and measured water levels in the four DEQ monitoring wells between September 12 and 16, 1991.

On October 22, 1991, VW&R's consultant, Harding Lawson Associates (HLA), conducted a soils investigation to confirm the presence and concentration of compounds detected during the soil gas survey. A total of four soil borings were drilled.

3.1 Soil Gas Survey and Groundwater Sampling

On September 12, 1991, VW&R and VW&R's consultant, HLA, measured water levels in the four DEQ monitoring wells and collected groundwater samples from two of the DEQ monitor wells, WP-1 and WP-2. Groundwater was encountered at depths ranging from 11.66 to 18.25 feet below the tops of the well casings. Groundwater was calculated to flow toward the west-northwest at an approximate gradient of 0.001 to 0.003 ft/ft.

The groundwater samples collected from Well WP-1 contained PCE, trichloroethylene (TCE), and 1,2-dichloroethylene (DCE) (cis and trans) at concentrations of 5100, 70, and 63 micrograms per liter (ug/l), respectively. Groundwater from Well WP-2 contained PCE and 1,1,1-trichloroethane (TCA) at concentrations of 6.1 and 2.0 ug/l, respectively. The results of HLA's groundwater sample analyses are included in Appendix B.

Between September 13 and 17, 1991, Hydro Geo Chem Inc., of Tucson, Arizona, evaluated the distribution of volatile organic compounds (VOCs) in the subsurface by conducting a soil gas survey under the supervision of HLA and VW&R. The soil gas was analyzed for PCE and its degradation products TCE, trans- and cis-1,2 DCE, vinyl chloride (VC), and total hydrocarbons (THC). Thirty-four soil gas samples were collected from sample locations distributed across the study area (Plate 3).

PCE was detected in 25 of the 34 samples at concentrations ranging from 0.11 to 5,500 ug/l. TCE was detected in 18 samples at concentrations ranging from 0.03 to 1,800 ug/l. Cis-1,2 DCE was detected in 10 samples at concentrations ranging from 0.6 to 540 ug/l. Total hydrocarbons were detected in all of the samples except SG-27. Total hydrocarbons concentrations ranged from 7 to 55,000 ug/l. Vinyl chloride was detected in samples collected from SG-10 and SG-11 at concentrations of 5.8 and 3.3 ug/l, respectively. Trans-1,2 DCE was detected in samples collected from SG-10 and SG-11 at concentrations of 2.2 and 0.71, respectively.

Appendix A contains the measured soil gas concentrations from each sampling location and Plate 4 illustrates the PCE soil gas concentrations.

Although ethylbenzene was not a requested analyte (it was not stored in bulk at the VW&R facility, handled as an industrial solvent at the VW&R facility, nor a degradation product of PCE), it was identified in the chromatograms at elevated concentrations. Ethylbenzene was detected in samples SG-10 through SG-12, and SG-14 through SG-20, at concentrations ranging from 2 to 1,200 ug/l.

3.2 Soil Drilling and Sampling

On October 22, 1991, HLA conducted a soils investigation to confirm the presence and concentration of compounds detected during the soil gas survey and to obtain information to enable design of the vapor extraction system recovery piping for the soil vapor extraction system pilot study. A total of four soil borings were drilled to groundwater. Soil samples were collected at two foot intervals. A subset of the soil samples was screened with an Organic Vapor Meter (OVM) to obtain field vapor readings. The highest OVM vapor readings were obtained from samples collected from the four to nine foot depth.

Clayey or silty sand, silt, and clay were present to depths between seven and nine feet below ground surface (bgs). Below this depth a silty to sandy gravel and gravelly sand were identified to the maximum depth of drilling, between 13.5 and 14.5 feet bgs. Groundwater was encountered between 12.5 and 14 feet bgs.

Three soil samples from each boring were selected for chemical analysis; a sample collected immediately above the water table and two additional samples that exhibited elevated levels of VOCs identified by OVM measurements. The soil samples were analyzed for VOCs using EPA Test Methods 8010 and 8020, Total Petroleum Hydrocarbons (TPH) using EPA Method 8015 (modified). Moisture content and grain size were also determined for selected samples. A report presenting the results of the soil boring investigation has been submitted under separate cover.

PCE was detected in all of the 14 soil samples at concentrations ranging from 26,000 to 0.05 mg/kg. The highest concentrations were found in soil samples collected from near the former PCE tank location. TCE was detected in 4 of the 14 soil samples at concentrations between 0.4 and 3.1 mg/kg. Cis 1,2-DCE was collected in two samples at concentrations of 1.3 and 0.52 mg/kg. Carbon Tetrachloride and 1,1,1-TCA were each detected in one soil sample at concentrations of 0.18 and 0.016 mg/kg, respectively. Methylene chloride was detected in 12 of the 14 soil samples at concentrations ranging from 0.15 to 1.1 mg/kg. Since methylene chloride was also detected in the associated blank sample, a laboratory source for the compound is suggested.

4.0 TECHNICAL APPROACH

4.1 Objectives

VW&R proposes a soil vapor extraction pilot study in the area of the Pier 1 Imports store located at the Boise Town Square Mall to mitigate the migration of contamination and to accomplish expedited source control in soils that have been affected by volatile organic compounds. VW&R has successfully implemented soil vapor extraction at a variety of other locations to effectively remove volatile compounds from soils. The system which is proposed for use at the Pier 1 site is similar to the systems which have been successfully employed by VW&R at other locations. The pilot system is designed to enable expansion to accommodate removal of volatiles from additional areas, as appropriate.

4.2 Methodology

A pilot study using vapor recovery and activated carbon units is proposed to recover volatile organic compounds from the subsurface. VOCs in the recovered airstream will be removed by the activated carbon component of the system. VOCs previously identified in the soil gas and soil samples are effectively removed by carbon adsorption (Appendices A and C). The unit is a self-contained, trailer-mounted, modular unit to allow for convenient set up and transportation to the site (Figure 1). The system will be used, initially, to reduce elevated VOC levels encountered in the vicinity of the Pier 1 Imports store.

The methodology proposed in this work plan is a proven "state-of-the-art" technique chosen for its specific applicability to on-site conditions, and for efficient operation. The vapor recovery unit is capable of operating in an automatic mode for 24 hours per day. Appendix D contains time versus concentration graphs produced from VES operations at a VW&R facility in Spokane, Washington. The treatment equipment used at this site is essentially the same as that proposed for the vapor extraction system in Boise. However, the extraction wells are individual wells rather than horizontal piping, as planned for the Boise site. Both systems involve removal of VOCs from alluvial sediments even though the specific depths and lithologic units are not identical. The graphs clearly illustrate the "rebound effects" of cyclical operation.

4.3 Operational Concept

The vapor extraction system consists of a positive displacement blower, activated carbon canisters, and associated controls. The positive displacement blower provides for an adjustable vacuum at the vapor recovery wellhead of between 0 and 4 inches of mercury.

This variable vacuum suction allows for adjustment to assure optimum air movement in the subsurface. The initial extraction rate will be 700 cubic feet per minute (cfm) or less.

The extracted vapors are routed through dual activated carbon canisters operated in series. These canisters are designed to operate at 3 feet per second linear velocity or less. The adsorptive media will be Cameron Yakima activated carbon, sieve size 4x6. This material has been shown to be effective in absorbing the VOCs present in the soil.

Space is provided between the blower and the carbon canisters to allow for installation of additional equipment to control humidity and secondary treatment systems should this prove necessary. Sampling ports are provided so that system efficiency and air influent and effluent quality can be monitored. An additional sampling port is located between the carbon beds. A flow diagram of this system is contained in Appendix E.

The module operates under positive ventilation to prevent the buildup of vapors inside the unit. Ventilation fans are interlocked through the control panel with the blower such that the blower will not operate unless the module ventilation fans are operating.

The horizontal vapor extraction piping will be located in or near the zone of elevated organic volatile compounds in soils, identified by the soil gas and soil sample analytical results. The locations of the vapor extraction piping and vapor monitoring wells are, in part, controlled by the physical limitations of the property which include an extensive network of underground utilities located in and around the Pier 1 property. Horizontal extraction piping was selected versus individual wells to maximize the zone of influence of the vapor extraction system.

The horizontal perforated PVC piping will be placed in trenches at a depth of approximately 7 feet bgs to optimize vapor removal from the zone of soil contamination with the highest measured VOC concentrations. Piping placement at this depth will also prevent groundwater intrusion. The trenches will be located to the north and east of the Pier 1 Imports building at locations where high soil gas vapors and VOCs from soil samples were detected (Plate 5). During the vapor extraction trench installation, VOC vapor measurements will be collected to monitor health and safety conditions and to confirm the extent of soil contamination between the soil boring locations.

The vapor recovery system modular unit will be connected to the horizontal vapor extraction piping using PVC piping. At five locations along the horizontal vapor extraction piping, traffic-rated utility boxes containing a valve and sampling port will be placed so that air flow rate from different sections of the vapor

extraction piping can be sampled, balanced, and controlled (Figures 2 and 3). Modification of the system is possible by closing off sections of the vapor extraction piping via the individual valves and by connecting new segments of vapor extraction piping to the system. Modification to the system will be considered based on the results of actual operational data.

Three vapor monitoring wells will be installed at approximate distances of 5, 15, and 30 feet from the east "leg" of the vapor extraction piping (Plate 5). Because of the presence of underground utilities, one well will be installed to the west of the extraction piping and two wells will be installed to the east. The vapor monitoring wells will be drilled to an approximate depth of 7 feet bgs and will be housed inside a traffic-rated vault (Plate 6). The vapor wells will be monitored for both vapor concentrations and flow. The schedule of vapor measurements and sampling of the vapor monitoring wells are included in Table 1.

To determine the zone of influence of the vapor extraction unit, flow will be measured in the vapor monitoring wells. Three techniques will be used to measure flow, which include: vacuum gauge measurements, air velocity meter measurements, and performance of a smoke test to physically observe air flow patterns into and around the extraction wells. Depending on the construction and location of the vapor wells, the subsurface lithology and structure, one or a combination of these techniques will be capable of measuring flow. Extensive experience from the design and operation of other vapor extraction systems has shown that pressure may not be an adequate measure of flow and is not necessary to optimize system performance.

Vapor concentration and flow measurements from the vapor monitoring wells in conjunction with measurements obtained from the influent, effluent, and vapor extraction piping sample ports will provide an estimate of the operating efficiency of the system and its effectiveness of VOC removal along different segments of the vapor extraction piping.

4.4 Sampling Techniques and Monitoring Schedules

Two types of vapor concentration monitoring will be performed to ensure successful operation of the system, which include laboratory analyses and Model 580B Organic Vapor Meter (OVM) measurements. Table 1, Vapor Sampling and Monitoring Schedule, summarizes the sampling locations, type of monitoring, and sampling frequencies.

At the initial start up of the pilot vapor extraction system, a soil-gas sample will be collected from the influent sampling port and the three vapor monitoring wells. The samples will be analyzed for VOC concentrations to establish initial, pre-operation conditions. Subsequent samples for VOC laboratory analysis will be

collected from the influent and effluent sampling ports and the three vapor monitoring wells according to the following schedule:

1. 7 days after start up
2. 45 days after start up
3. Quarterly for first year
4. Semi-annual after first year until the unit is removed from service

Sampling from the influent and effluent ports and the vapor monitoring wells will consist of collection of a 1.5 liter sample in a Tedlar bag. Dedicated fittings and teflon tubes will be used for all sampling to prevent cross contamination. New Tedlar bags will be used for each sample to avoid problems with decontamination or reuse of the bag.

In addition, the gas stream will be monitored using a Model 580B Organic Vapor Meter to assure that VOCs are not being discharged and to obtain data to operate the system efficiently. The OVM is used to quickly, with no delay for awaiting analytical results, determine if breakthrough has occurred and to obtain qualitative data to maximize operating efficiency. The VOC concentration in the gas stream at the influent and effluent sampling ports in addition to the sampling port between the carbon beds will be sampled to ensure that the carbon system is functioning as designed. The VOC concentrations in the three vapor monitoring wells and the vapor extraction piping sample ports will be monitored to evaluate operating conditions. This sampling shall be performed with an OVM meter calibrated to manufactures' specifications.

During the first week of operation, at a minimum, the gas streams will be monitored daily with the OVM. After the first week of operation, the gas streams will be monitored on a weekly schedule until the time interval between breakthrough, as measured by the OVM, is greater than four weeks for two consecutive periods or until the breakthrough interval for a single period is greater than eight weeks. Once either condition has been met, OVM sampling frequencies will be on a monthly basis. Breakthrough is defined by the DEQ Air Quality Permit to Construct #0020-00096, to be VOC concentrations 2.5 times the background level, in the effluent air stream after its circulation through the first carbon canister, as measured by a Model 580B OVM calibrated to manufacturer's specifications.

When breakthrough is detected in the first carbon bed, it will be replaced with the second bed and a new carbon bed will replace the second carbon bed. It should be noted that the first carbon bed is designed to remove the VOCs to appropriate air quality standards,

while the second carbon canister is present to insure that no inadvertent releases of VOCs will occur due to unexpected breakthrough at the first canister.

4.5 Chemical Analyses

All analytical procedures for soil-gas samples will follow procedures outlined in Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/600/4-89/017, June 1988. Samples collected during the pilot study will be analyzed for VOCs using appropriate U.S.EPA Test Methods.

Analytical procedures for carbon samples will follow U. S. EPA Publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (U.S. EPA, 1986d). Carbon samples will be analyzed by EPA Test Methods 8010 and 8020.

4.6 Quality Assurance/Quality Control

QA/QC procedures will be employed during all sampling events to ensure that the analytical results of the soil-gas and air samples will be accurate, consistent, and representative of actual site conditions. All activities will be conducted under the supervision of VW&R personnel.

Construction activities associated with the proposed pilot vapor extraction system will be under the supervision of VW&R project personnel. The soil vapor recovery unit will be constructed in modular form by a contractor experienced in the fabrication of these systems. During the construction process, random inspections will be conducted by the Pilot System Design Engineer and Project Manager to ensure compliance with the project specifications. A final off-site inspection of each unit will be conducted prior to acceptance by VW&R.

Prior to start up of the systems, a complete inspection of the unit will be conducted by VW&R project personnel. In addition, personnel assigned to operate the unit will be thoroughly trained in the operation of each unit and their components, emergency shut-down and communication procedures, and in operational theory of each unit.

4.7 Operation and Maintenance

Typically, vapor extraction system operations are continuous until vapor concentrations begin to decline. As vapor concentrations begin to decline during continuous operation, cyclical operation of the system will be initiated. Cyclical operation involves intermittent periods of continuous operation and shut down.

Following system shutdown, rebound of vapor concentrations will occur. Cyclical operation of the system will continue until no rebound in vapor concentrations occurs over several cycles. At this point, the system will have achieved its practical limit of VOC removal. Soil samples will be collected and analyzed for the compounds known to be present to verify cleanup. These data will be submitted to the Division for review prior to actual removal and dismantling of the VES equipment.

The system will be operated in compliance with the requirements established in the DEQ Air Quality Permit to Construct # 0020-0096. Operation and maintenance manuals will be prepared before operation of the system is initiated. The manuals will be prepared by the design team associated with the pilot vapor extraction system. At a minimum, this team will consist of VW&R project personnel, the treatment module construction contractor, and the VW&R design engineer responsible for the design of the units.

Only authorized personnel will be allowed to operate the treatment unit. Routine maintenance will also be conducted by VW&R personnel or by personnel under their direct supervision.

Contaminant build-up on the activated carbon will be tracked by monitoring the effluent from the vapor recovery unit and the air stream between the two carbon canisters with an OVM. This monitoring will be conducted on a routine basis as part of the normal maintenance schedule by the designated operators. Carbon, thought to be contaminated, will be removed from service and replaced with fresh activated carbon. The used carbon will be treated as a hazardous waste unless it can be demonstrated, in accordance with 40 CFR 261.3(c) or (d), that it is not a hazardous waste. Waste carbon will be sampled and analyzed according to EPA Test Methods, 8010 and 8020 to determine the concentration of compounds known or suspected to be present. If the waste carbon is determined to be a regulated hazardous waste, then the waste carbon will be manifested to an off-site RCRA TSD facility for proper treatment and/or disposal. The results of the carbon analyses will be compiled and used to identify the total mass of compounds removed from the subsurface.

5.0 REPORTS

Upon approval of this Work Plan, VW&R will submit quarterly progress reports summarizing all activities which occurred during the reporting period. The progress reports will include the following:

1. A description of all pilot system activities completed.
2. Summaries of all analytical results listing the sampling location, the constituents analyzed, and the dates of sampling and analysis.
3. Performance data including, but not limited to, flow rates through the treatment system, estimates of the contaminant mass removed, and influent, effluent, and monitoring wells' vapor quality.
4. Identification of problems or potential problems and required modifications to the pilot vapor extraction system.
5. Schedule for the next reporting period.

6.0 PROJECT PERSONNEL

All phases of the pilot study will be conducted by, or under the direct supervision of VW&R senior professional personnel. All senior personnel proposed have previous experience on this or similar projects for VW&R and were selected for their particular capabilities, expertise, and knowledge. Experienced sampling personnel will be selected from either Harding Lawson Associates or from a local, qualified environmental consultant.

7.0 HEALTH AND SAFETY

All on-site activities will be conducted under the supervision of senior project personnel and in strict accordance with an approved Health & Safety Plan. On-site project personnel of VW&R and its subcontractors will be required to read and follow the provisions of the Health & Safety Plan (Appendix F).

Specific health and safety issues regarding the operation of the various components of the treatment systems will be addressed in the operation manuals of the systems. No personnel will be allowed to operate the equipment unless thoroughly trained in their operational and emergency shut-off procedures.

TABLE

TABLE 1:

VAPOR SAMPLING AND MONITORING SCHEDULE

A: LABORATORY ANALYSES

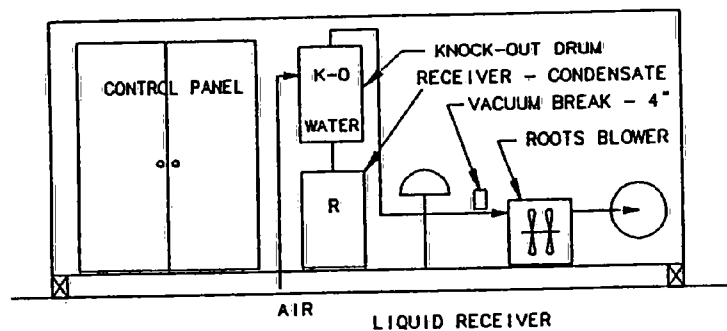
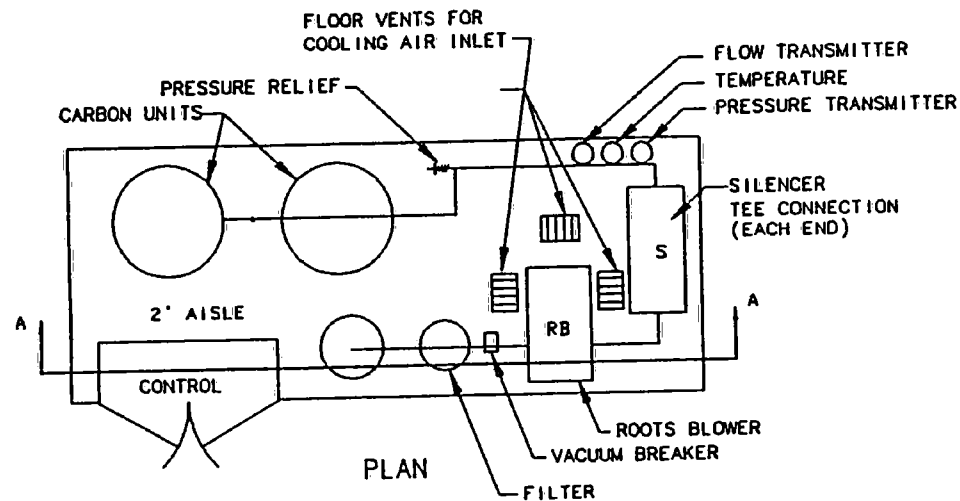
	STARTUP	7 DAYS	45 DAYS	QUARTERLY FIRST YEAR	SEMIANNUAL UNTIL COMPLETION
INFLUENT	*	*	*	*	*
EFFLUENT		*	*	*	*
VAPOR WELLS	*	*	*	*	*

B: OVM MONITORING

	DAILY FIRST WEEK	WEEKLY UNTIL AIR PERMIT CONDITIONS MET (3)	MONTHLY UNTIL COMPLETION
INFLUENT	*	*	*
EFFLUENT	*	*	*
CANISTER (1)	*	*	*
VAPOR WELLS	*	*	*
VES PIPING (2)	*	*	

-
1. Sampling port located between the carbon canisters
 2. VES extraction piping sampling ports
 3. Vapors will be monitored weekly until the time interval between breakthrough is greater than four weeks for two consecutive periods or until the breakthrough interval for a single period is greater than eight weeks.

FIGURES

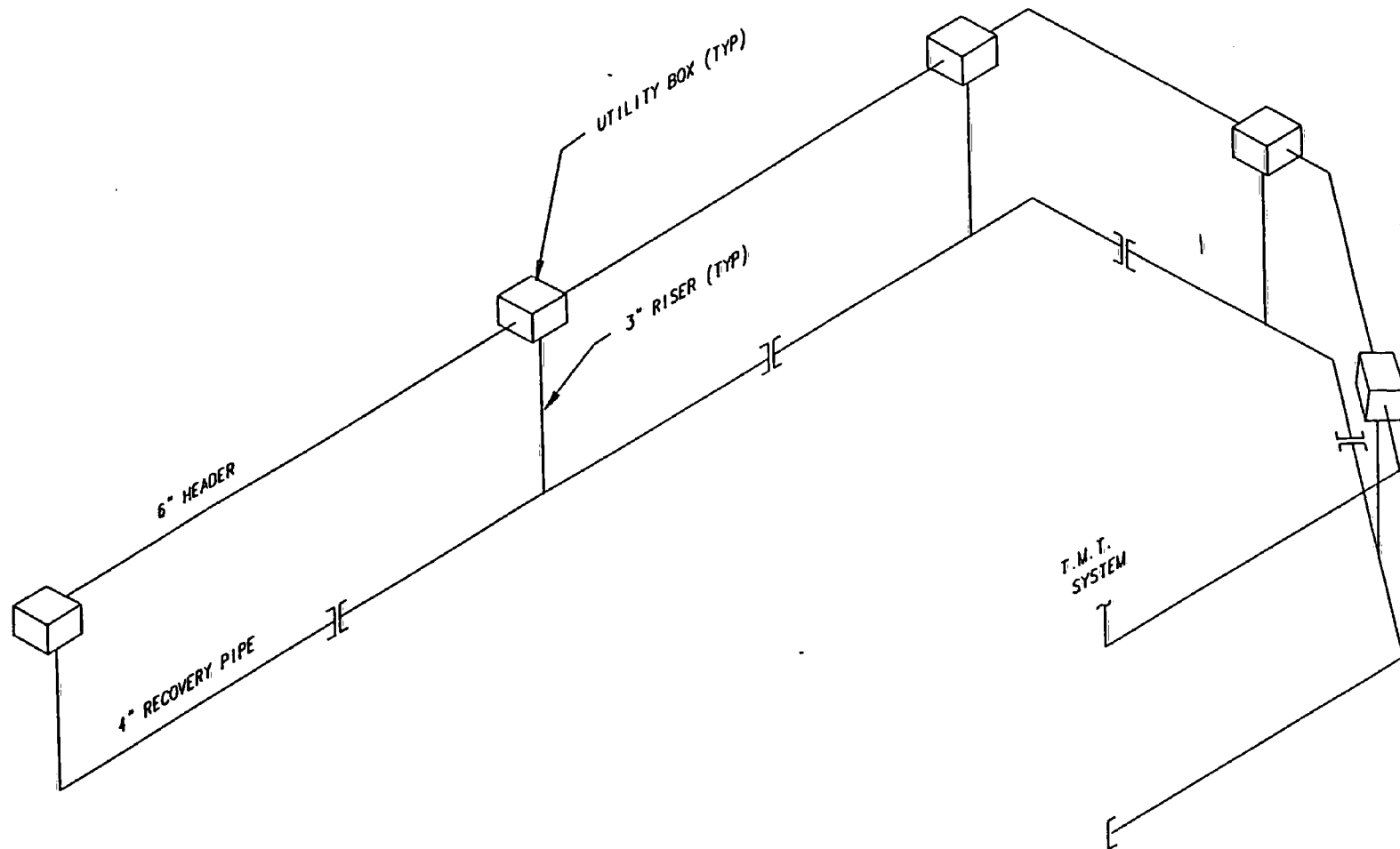


CROSS SECTION AA

J. POWELL & ASSOCIATES

DRWN PJM
APPR
DATE 10-29-81
REV#
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FIGURE 1
CONTAINER PLAN AND CROSS SECTION
VAN WATERS & ROGERS INC.
BOISE, IDAHO

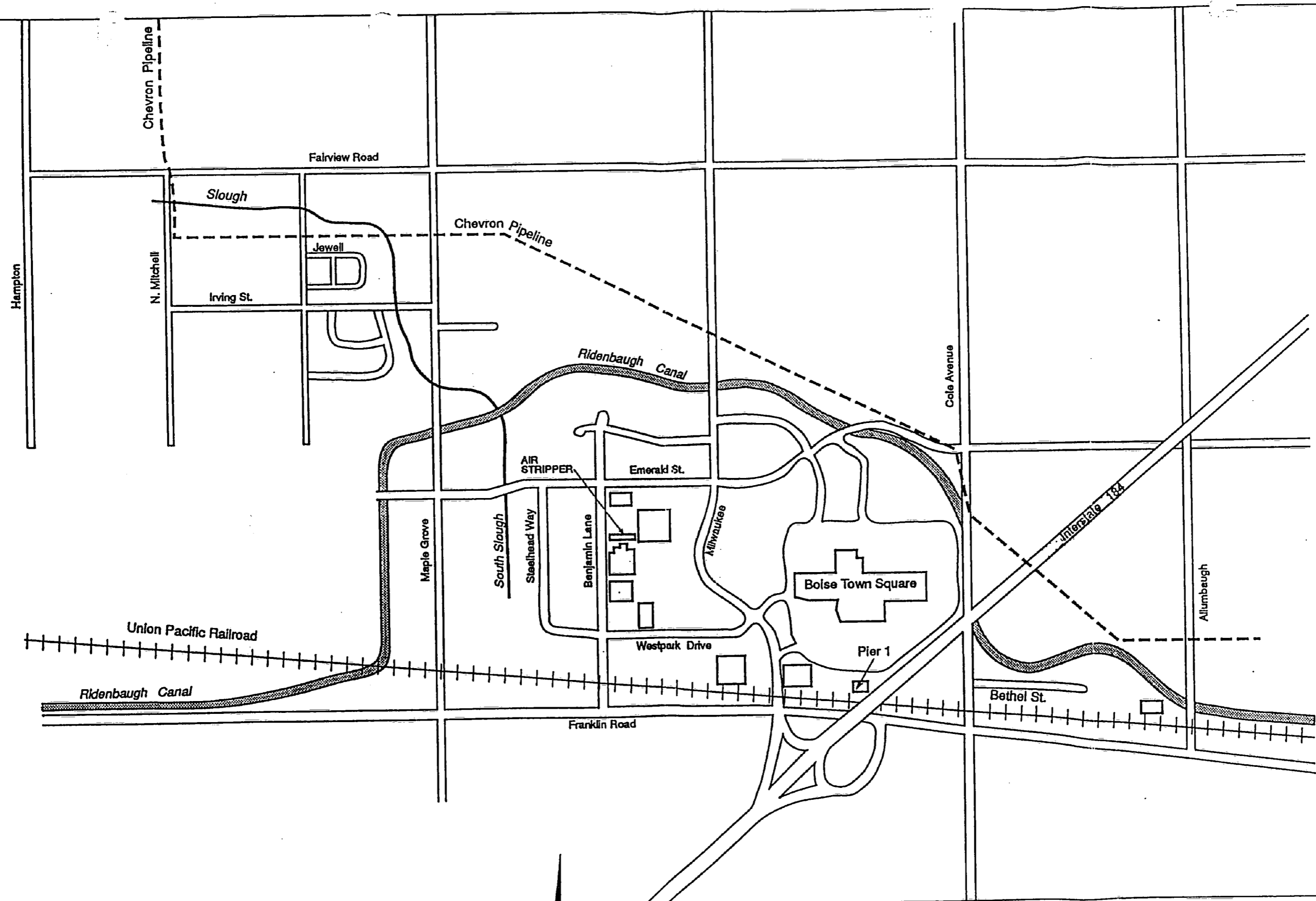


J. POWELL & ASSOCIATES

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 DATE 10-29-91
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FIGURE 3
 SOIL VENTING SYSTEM PIPING ARRANGEMENT
 VAN WATERS & ROGERS INC.
 BOISE, IDAHO

PLATES



0 1000 2000
Approximate Scale in Feet



Harding Lawson Associates
Engineering and
Environmental Services

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JOB NUMBER
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Area Map
Work Plan
Pilot Soil Vapor Extraction System
Boise, Idaho

APPROVED

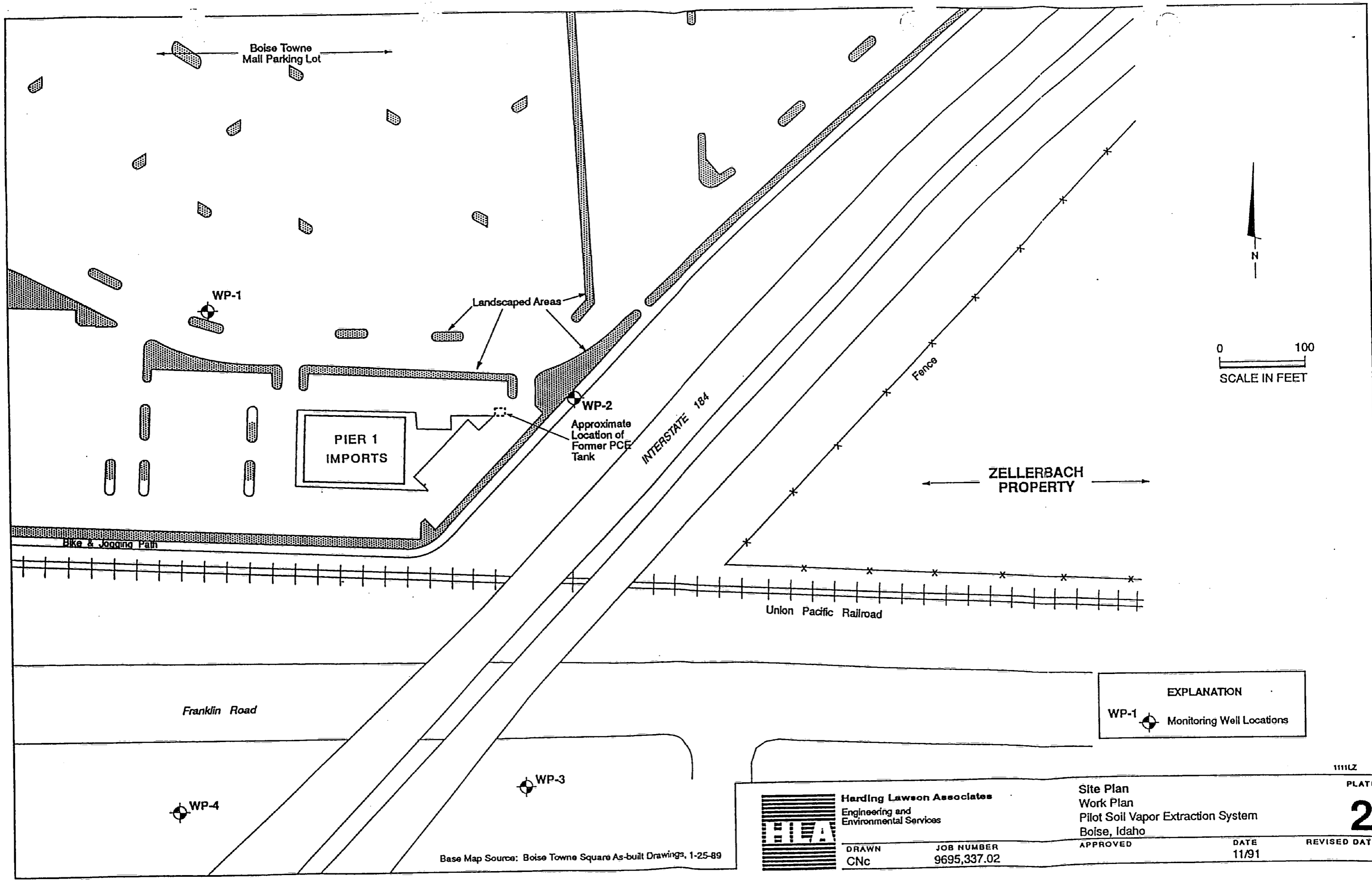
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PLATE

1



Base Map Source: Boise Towne Square As-built Drawings, 1-25-89



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Environmental Services

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CNC

JOB NUMBER
9695,337.02

Site Plan
Work Plan
Pilot Soil Vapor Extraction System
Boise, Idaho

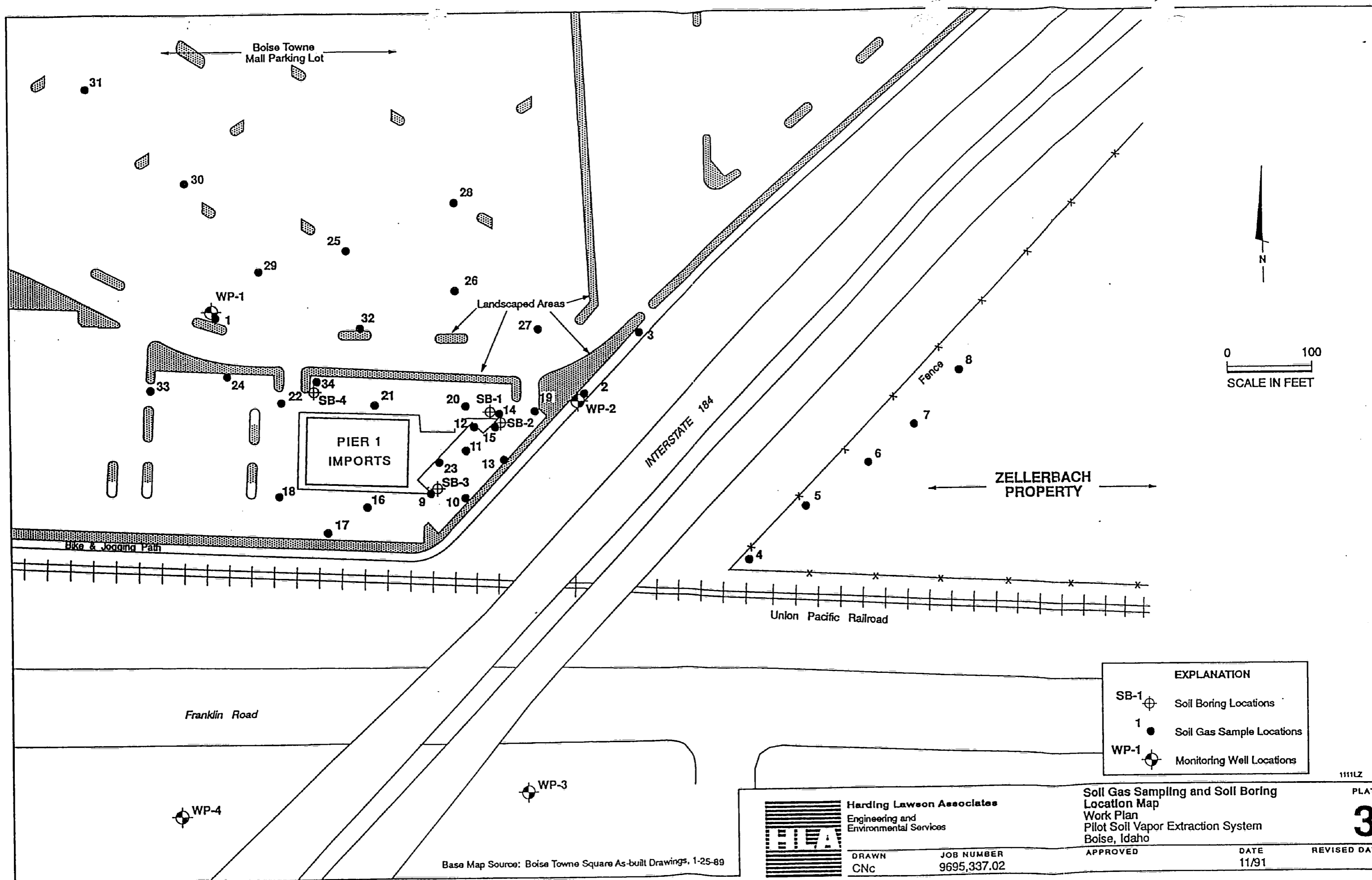
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PLAT

2



EXPLANATION	
SB-1	Soil Boring Locations
1	Soil Gas Sample Locations
WP-1	Monitoring Well Locations



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Soil Gas Sampling and Soil Boring
Location Map
Work Plan
Pilot Soil Vapor Extraction System
Boise, Idaho

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PLATE
3

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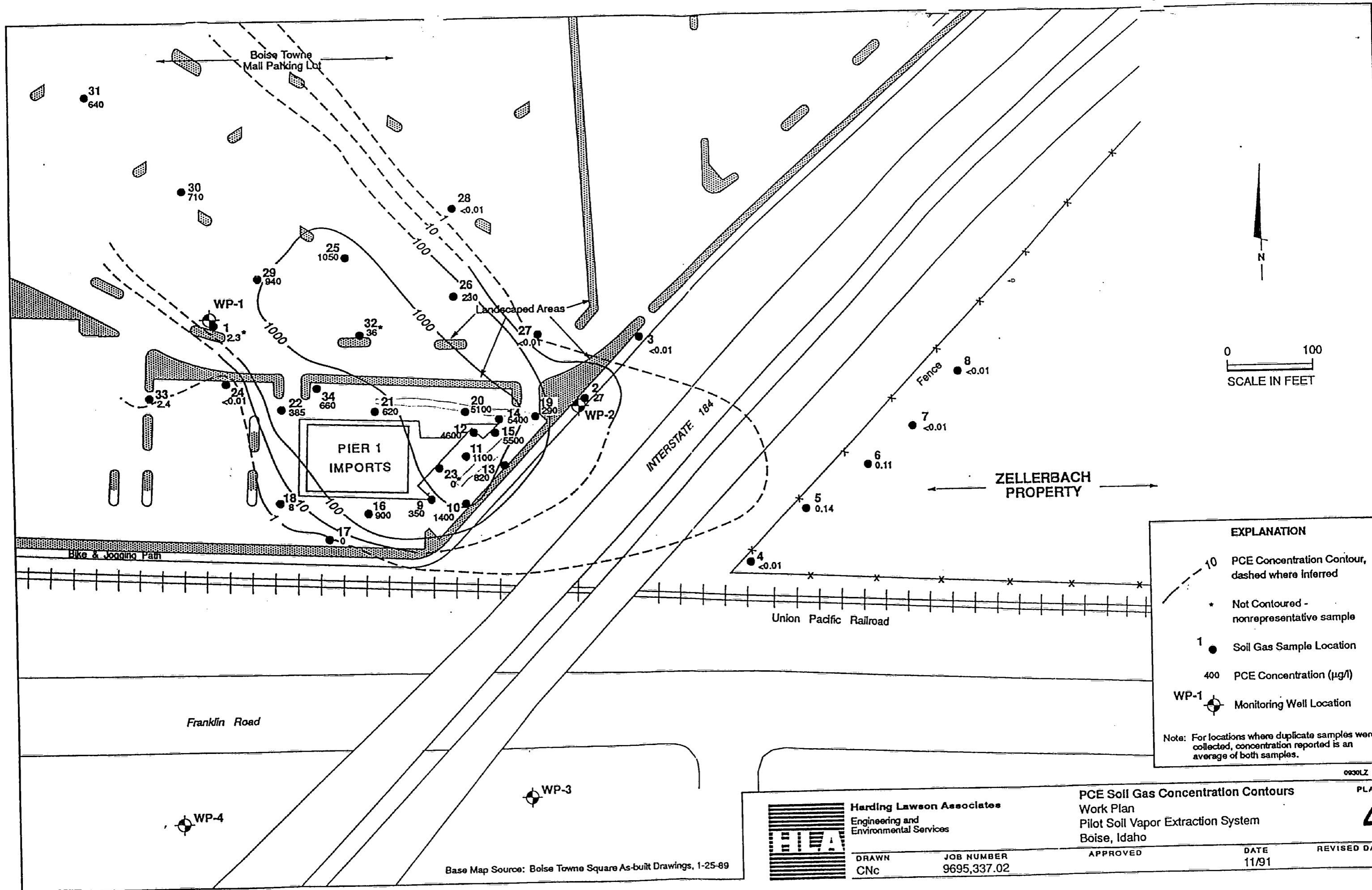
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REVISED DATE

Base Map Source: Boise Towne Square As-built Drawings, 1-25-89



Base Map Source: Boise Towne Square As-built Drawings, 1-25-89



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Environmental Services

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JOB NUMBER
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PCE Soil Gas Concentration Contours
Work Plan
Pilot Soil Vapor Extraction System
Boise, Idaho

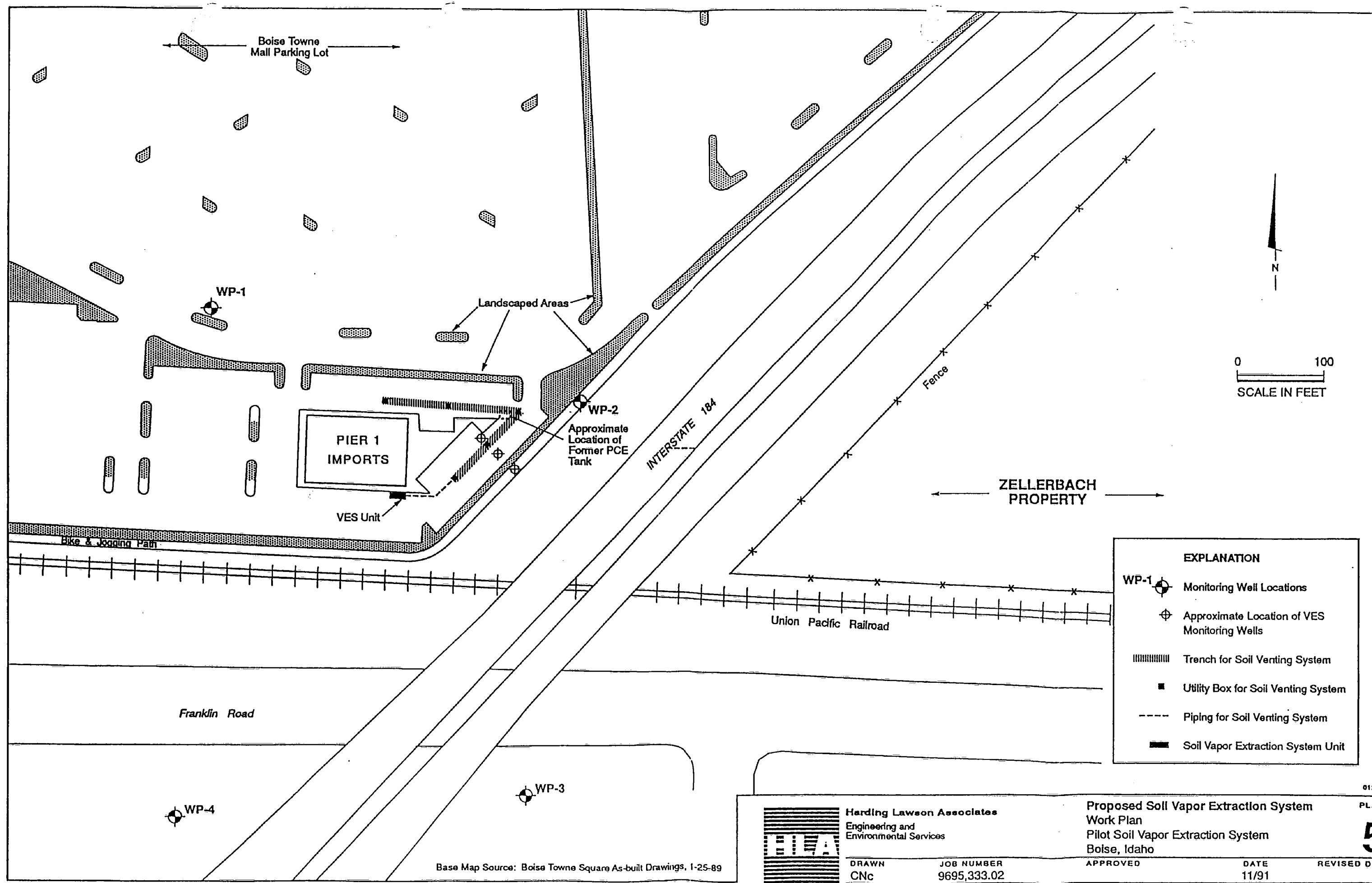
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Environmental Services

**Proposed Soil Vapor Extraction System
Work Plan**
Pilot Soil Vapor Extraction System
Boise, Idaho

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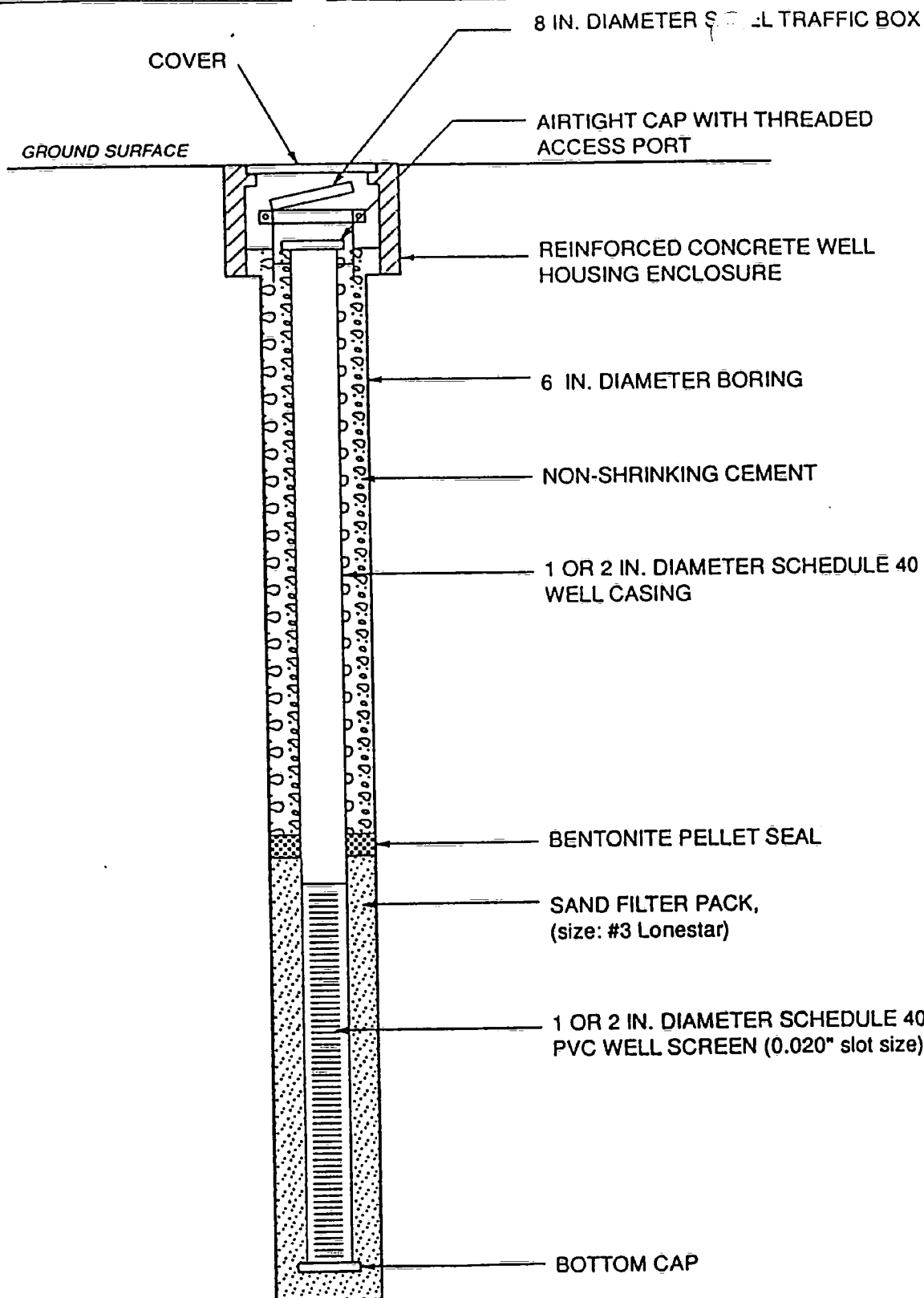
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Typical VES Monitoring Well Diagram
Work Plan
Pilot Soil Vapor Extraction System
Boise, Idaho

PLATE

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DRAWN JOB NUMBER
EHc 9695,333.02

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DATE
1/92

REVISED DATE

APPENDIX A
SOIL GAS ANALYTICAL RESULTS

TABLE 1
SUMMARY OF ANALYTICAL RESULTS

SAMPLE	DEPTH FT	VCL	TDCE	CDCE	TCE	PCE	THC	COMMENT
FB13SEP#1		<0.01	<0.01	<0.01	<0.01	<0.01	<1.00	
FB15SEP#1		<0.01	<0.01	<0.01	<0.01	<0.01	<1.00	
FB16SEP#1		<0.01	<0.01	<0.01	<0.01	<0.01	<1.00	
FB16SEP#2		<0.01	<0.01	<0.01	<0.01	<0.01	<1.00	
WATER		<0.01	<0.01	<0.01	<0.01	39.00	100.00	
SG-001-A	7.5	<0.01	<0.01	<0.01	0.16	2.20	25	
SG-001-B	7.5	<0.01	<0.01	<0.01	0.12	2.40	15	
SG-002-A	9.0	<0.01	<0.01	<0.01	<0.01	26.00	38	
SG-002-B	9.0	<0.01	<0.01	<0.01	0.03	28.00	42	
SG-003	9.0	<0.01	<0.01	<0.01	<0.01	<0.01	23	
SG-004	6.7	<0.01	<0.01	<0.01	<0.01	<0.01	9	
SG-005	11.0	<0.01	<0.01	<0.01	0.04	0.14	22	
SG-006	7.0	<0.01	<0.01	<0.01	<0.01	0.11	13	
SG-007-A	8.5	<0.01	<0.01	<0.01	<0.01	<0.01	10	
SG-007-B	8.5	<0.01	<0.01	<0.01	<0.01	<0.01	13	
SG-008	5.0	<0.01	<0.01	<0.01	<0.01	<0.01	7	
SG-009	5.5	<0.01	<0.01	0.60	9.30	350.00	230	Unknown Aromatic
SG-010	7.0	5.80	2.20	74.00	70.00	1400.00	6200	Ethyl Benzene 250
SG-011	5.5	3.30	0.71	57.00	38.00	1100.00	2600	Ethyl Benzene 140
SG-012	9.0	<0.01	<0.01	120.00	1800.00	4600.00	55000	Ethyl Benzene 730
SG-013-A	8.0	<0.01	<0.01	17.00	57.00	1300.00	2500	Unknown Aromatic
SG-013-B	8.0	<0.01	<0.01	<0.01	6.20	400.00	320	Unknown Aromatic-NO
SG-014-A	6.5	<0.01	<0.01	290.00	170.00	5500.00	21000	Ethyl Benzene 630
SG-014-B	6.5	<0.01	<0.01	380.00	150.00	5300.00	20000	Ethyl Benzene 1200
SG-015	6.0	<0.01	<0.01	540.00	380.00	5500.00	20000	Ethyl Benzene 830
SG-016	9.0	<0.01	<0.01	<0.01	11.00	900.00	1400	Ethyl Benzene 2
SG-017	9.0	<0.01	<0.01	<0.01	<0.01	<0.01	60	Ethyl Benzene 2
SG-018	9.0	<0.01	<0.01	<0.01	<0.01	8.00	59	Ethyl Benzene 2
SG-019	6.0	<0.01	<0.01	18.00	<0.01	290.00	320	Ethyl Benzene 2
SG-020	9.0	<0.01	<0.01	400.00	460.00	5100.00	53000	Ethyl Benzene 640
SG-021	5.5	<0.01	<0.01	<0.01	14.00	620.00	500	
SG-022-A	7.0	<0.01	<0.01	<0.01	9.10	420.00	290	
SG-022-B	7.0	<0.01	<0.01	<0.01	<0.01	350.00	220	

TABLE 1
SUMMARY OF ANALYTICAL RESULTS (CONTINUED)

SAMPLE	DEPTH FT	VCL	TDCE	COCE	TCE	PCE	THC	COMMENT
SG-023	7.5	<0.01	<0.01	<0.01	<0.01	<0.01	26	
SG-024	7.5	<0.01	<0.01	<0.01	<0.01	<0.01	25	
SG-025-A	5.5	<0.01	<0.01	12.00	17.00	1100.00	1500	
SG-025-B	5.5	<0.01	<0.01	9.40	18.00	1000.00	1400	
SG-026	7.0	<0.01	<0.01	<0.01	11.00	230.00	560	
SG-027	7.0	<0.01	<0.01	<0.01	<0.01	<0.0	<1.00	No Surrogate
SG-028	9.0	<0.01	<0.01	<0.01	<0.01	<0.01	37	
SG-029	9.0	<0.01	<0.01	<0.01	62.00	940.00	1100	
SG-030	7.5	<0.01	<0.01	<0.01	<0.01	710.00	630	
SG-031	9.0	<0.01	<0.01	<0.01	<0.01	640.00	610	
SG-032-A	5.0	<0.01	<0.01	<0.01	<0.01	40.00	42	
SG-032-B	5.0	<0.01	<0.01	<0.01	<0.01	32.00	36	
SG-033	9.0	<0.01	<0.01	<0.01	<0.01	2.40	32	
SG-034	7.0	<0.01	<0.01	<0.01	18.00	660.00	600	

APPENDIX B
GROUNDWATER ANALYTICAL RESULTS

REPORT
Organics by GC (cont.)

ier
()

40A
40A
-38A
-40A

-A
JEIOUS
SEP 91-40A QC Run: 23 SEP 91-38A

	Result	Units	Reporting Limit
	ND	ug/L	0.50
loro-1,2,2-	ND	ug/L	1.0
ethane (Freon 113)	ND	ug/L	1.0
oethane	ND	ug/L	0.50
loroethane	ND	ug/L	0.50
achloride	ND	ug/L	1.0
romethane	ND	ug/L	1.0
opropane	ND	ug/L	1.0
ichloropropene	ND	ug/L	0.50
hene	ND	ug/L	1.0
romethane	ND	ug/L	2.0
hloropropene	ND	ug/L	1.0
loroethane	ND	ug/L	2.0
ethane	ND	ug/L	5.0
	ND	ug/L	1.0
rachloroethane	ND	ug/L	0.50
ethene	ND	ug/L	2.0
ne	ND	ug/L	

DUPLICATE CONTROL SAMPLE REPORT
Volatile Organics by GC

Analyte	Spiked	Concentration		AVG	Accuracy		Precision	
		DCS1	Measured DCS2		Average(%)	Limits	(RPD)	DCS Limit
Category: 601-A								
Matrix: AQUEOUS								
QC Lot: 19 SEP 91-40A								
Concentration Units: ug/l								
1,1-Dichloroethane	5.0	5.27	5.21	5.24	105	82-118	1.1	12
Chloroform	5.0	5.36	5.04	5.20	104	46-155	6.2	14
Bromodichloromethane	5.0	5.30	4.97	5.14	103	77-123	6.4	12
Trichloroethene	5.0	5.25	4.94	5.10	102	73-118	6.1	10
Chlorobenzene	5.0	5.46	5.32	5.39	108	66-123	2.6	13

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Volatile Organics by GC

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits

Category: 601-A
Matrix: AQUEOUS
QC Lot: 19 SEP 91-40A QC Run: 19 SEP 91-40A
Concentration Units: ug/l

Bromochloromethane	4.00	3.74	94	49-125
--------------------	------	------	----	--------

Category: 601-A
Matrix: AQUEOUS
QC Lot: 19 SEP 91-40A QC Run: 23 SEP 91-38A
Concentration Units: ug/l

Bromochloromethane	4.00	3.32	83	49-125
--------------------	------	------	----	--------

Calculations are performed before rounding to avoid round-off errors in calculated results.

Halogenated Volatile Organics

Method 8010

Client Name: Harding Lawson Associates
Client ID: 91091201
Lab ID: 060423-0001-SA
Matrix: AQUEOUS
Authorized: 13 SEP 91

Novato

Sampled: 12 SEP 91
Prepared: NA

Received: 13 SEP 91
Analyzed: 19 SEP 91

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	0.50
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene (cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	0.50
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	1.0
1,1,1-Trichloroethane	2.0	ug/L	0.50
Carbon tetrachloride	ND	ug/L	0.50
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	0.50
Trichloroethene	ND	ug/L	1.0
Dibromochloromethane	ND	ug/L	2.0
cis-1,3-Dichloropropene	ND	ug/L	1.0
1,1,2-Trichloroethane	ND	ug/L	2.0
1,2-Dibromoethane	ND	ug/L	5.0
Bromoform	ND	ug/L	1.0
1,1,2,2-Tetrachloroethane	6.1	ug/L	0.50
Tetrachloroethene	ND	ug/L	2.0
Chlorobenzene	ND	ug/L	2.0

Surrogate

Recovery

Bromochloromethane

79 %

ND = Not detected
NA = Not applicable

Reported By: Jennifer Neeley Bavetta Approved By: Marcia Reed

The cover letter is an integral part of this report.

Rev 230787

Halogenated Volatile Organics

Method 8010

Client Name: Harding Lawson Associates
Client ID: 91091202
Lab ID: 060423-0002-SA
Matrix: AQUEOUS
Authorized: 13 SEP 91

Novato

Sampled: 12 SEP 91
Prepared: NA

Received: 13 SEP 91
Analyzed: 19 SEP 91

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	0.50
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene	ND	ug/L	0.50
(cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	0.50
1,1,1-Trichloroethane	ND	ug/L	0.50
Carbon tetrachloride	ND	ug/L	1.0
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	0.50
Trichloroethene	ND	ug/L	1.0
Dibromochloromethane	ND	ug/L	2.0
cis-1,3-Dichloropropene	ND	ug/L	1.0
1,1,2-Trichloroethane	ND	ug/L	2.0
1,2-Dibromoethane	ND	ug/L	5.0
Bromoform	ND	ug/L	1.0
1,1,2,2-Tetrachloroethane	ND	ug/L	0.50
Tetrachloroethene	ND	ug/L	2.0
Chlorobenzene	ND	ug/L	2.0

Recovery

Surrogate

87 %

Bromochloromethane

ND = Not detected
NA = Not applicable

Reported By: Jennifer Neeley Bavetta
Approved By: Marcia Reed

The cover letter is an integral part of this report.
Rev 230787

Halogenated Volatile Organics

Method 8010

Client Name: Harding Lawson Associates
Client ID: 91091203
Lab ID: 060423-0003-SA
Matrix: AQUEOUS
Authorized: 13 SEP 91

Novato

Sampled: 12 SEP 91
Prepared: NA

Received: 13 SEP 91
Analyzed: 23 SEP 91

Parameter	Result	Units	Reporting Limit	
Chloromethane	ND	ug/L	100	R
Bromomethane	ND	ug/L	100	
Vinyl chloride	ND	ug/L	100	
Chloroethane	ND	ug/L	100	
Methylene chloride	ND	ug/L	100	
1,1-Dichloroethene	ND	ug/L	50	
1,1-Dichloroethane	ND	ug/L	50	
1,2-Dichloroethene	63	ug/L	50	
(cis/trans)	ND	ug/L	50	
Chloroform	ND	ug/L	50	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ND	ug/L	50	
1,2-Dichloroethane	ND	ug/L	50	
1,1,1-Trichloroethane	ND	ug/L	50	
Carbon tetrachloride	ND	ug/L	50	
Bromodichloromethane	ND	ug/L	50	
1,2-Dichloropropane	ND	ug/L	50	
trans-1,3-Dichloropropene	70	ug/L	50	
Trichloroethene	ND	ug/L	50	
Dibromochloromethane	ND	ug/L	60	
cis-1,3-Dichloropropene	ND	ug/L	50	
1,1,2-Trichloroethane	ND	ug/L	50	
1,2-Dibromoethane	ND	ug/L	50	
Bromoform	ND	ug/L	50	
1,1,2,2-Tetrachloroethane	5100	ug/L	50	
Tetrachloroethene	ND	ug/L	50	
Chlorobenzene				
Surrogate	Recovery			
Bromochloromethane	90	%		

Note R : Raised reporting limit(s) due to high analyte level(s).

ND = Not detected
NA = Not applicable

Reported By: Jennifer Neeley Bavetta Approved By: Marcia Reed

The cover letter is an integral part of this report.
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Halogenated Volatile Organics

Method 8010

Client Name: Harding Lawson Associates
Client ID: 91091204
Lab ID: 060423-0004-SA
Matrix: AQUEOUS
Authorized: 13 SEP 91

Novato

Sampled: 12 SEP 91
Prepared: NA

Received: 13 SEP 91
Analyzed: 19 SEP 91

Parameter	Result	Units	Reporting Limit	
Chloromethane	ND	ug/L	5.0	
Bromomethane	ND	ug/L	5.0	
Vinyl chloride	ND	ug/L	1.0	
Chloroethane	ND	ug/L	5.0	
Methylene chloride	ND	ug/L	5.0	
1,1-Dichloroethene	ND	ug/L	0.50	
1,1-Dichloroethane	ND	ug/L	0.50	
1,2-Dichloroethene				
(cis/trans)	ND	ug/L	0.50	
Chloroform	ND	ug/L	0.50	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1.2	ug/L	1.0	b
1,2-Dichloroethane	ND	ug/L	1.0	
1,1,1-Trichloroethane	ND	ug/L	0.50	
Carbon tetrachloride	ND	ug/L	0.50	
Bromodichloromethane	ND	ug/L	1.0	
1,2-Dichloropropane	ND	ug/L	1.0	
trans-1,3-Dichloropropene	ND	ug/L	1.0	
Trichloroethene	ND	ug/L	0.50	
Dibromochloromethane	ND	ug/L	1.0	
cis-1,3-Dichloropropene	ND	ug/L	2.0	
1,1,2-Trichloroethane	ND	ug/L	1.0	
1,2-Dibromoethane	ND	ug/L	2.0	
Bromoform	ND	ug/L	5.0	
1,1,2,2-Tetrachloroethane	ND	ug/L	1.0	
Tetrachloroethene	ND	ug/L	0.50	
Chlorobenzene	ND	ug/L	2.0	
Surrogate	Recovery			
Bromochloromethane	90	%		

Note b : Analytical results should not be considered reliable for this common lab contaminant unless the sample result exceeds 5 times the reporting limit or 10 times the blank result.

ND = Not detected
NA = Not applicable

Reported By: Jennifer Neeley Bavetta Approved By: Marcia Reed

The cover letter is an integral part of this report.
Rev 230787

APPENDIX C
SOIL SAMPLE ANALYTICAL RESULTS

Soil Sample Analytical Results
VW&R Boise
October 22, 1991

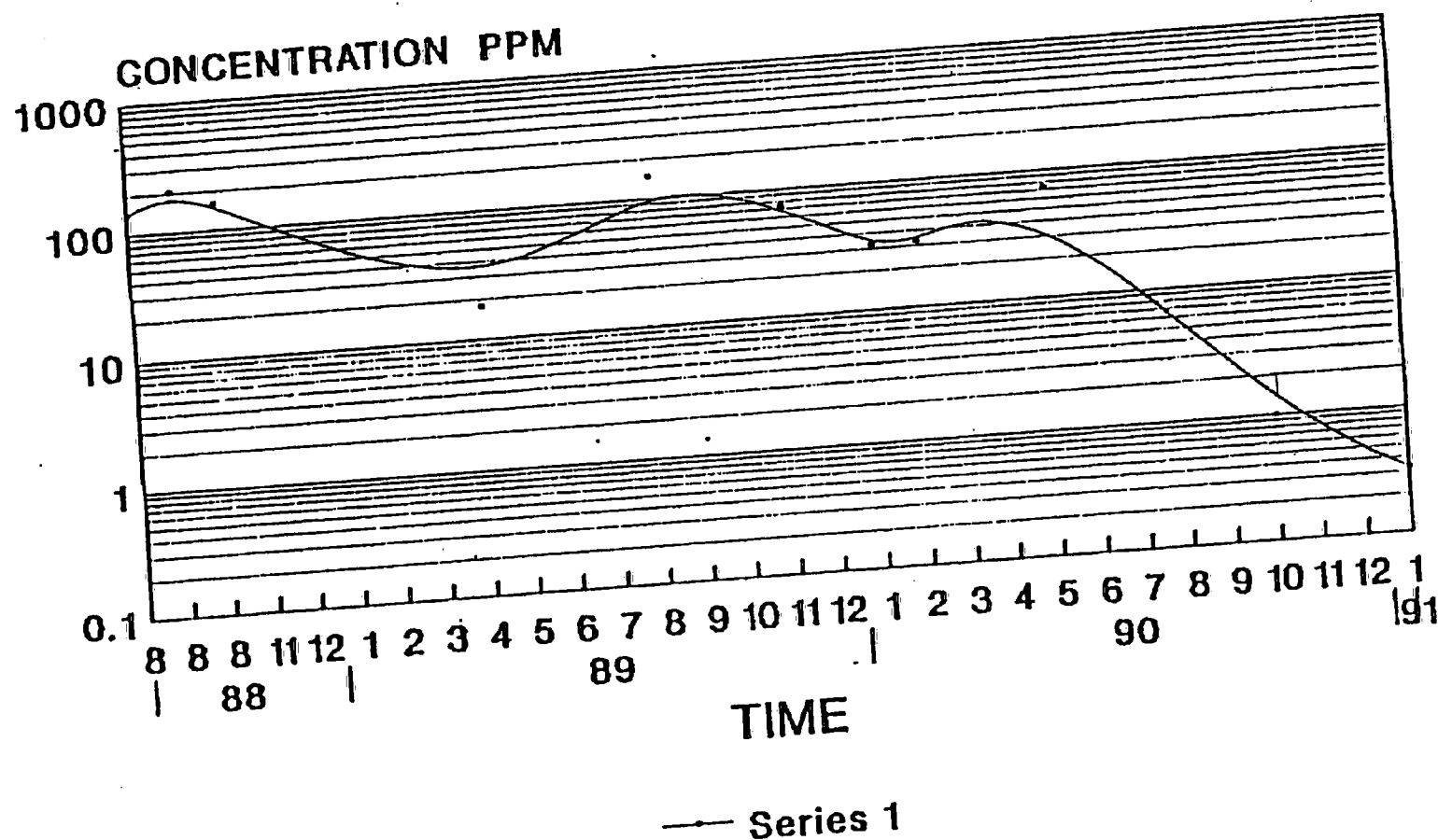
Harding Lawson Associates

Sample Number	Boring/Depth (feet)	Detected 8010/8020 Analytes ¹						TPH ¹		Moisture (%)	Grain Size Classification ⁵
		PCE	TCE	Methylene-Chloride ²	Carbon Tetrachloride	cis-1,2 DCE	1,1,1 TCA	Gasoline	Diesel		
91102204	B-1, 5.5	26,000	3.1	0.75	<0.05	1.3	<0.05	<5	<5	15	CH
91102205	B-1, 8.0	3,090	<5	<5	<5	<5	<5	NA ⁴	NA	NA	NA
91102206	B-1, 9.5	3,100	0.4	0.73	0.18	<0.05	<0.05	<5	<5	4.1	SP-SC
91102209 ³	B-1, 13.5	1,100	<0.05	0.78	<0.05	<0.05	<0.05	<5	<5	11	GW
91102211 ³	B-2, 4.5	3,300	1.5	0.63	<0.05	0.52	<0.05	<5	<5	18	CH
91102215 ³	B-2, 9	840	0.51	0.65	<0.05	<0.05	<0.05	<5	<5	4.7	CH (at 6.5 feet)
91102216	B-2, 8.5	3,100	<5	<5	<5	<5	<5	NA	NA	NA	NA
91102218	B-2, 12.5	4.0	<0.01	0.20	<0.01	0.014	<0.01	<5	<5	11	SC
91102220	B-3, 4	0.23	<0.01	0.22	<0.01	<0.01	<0.01	<5	<5	7.5	SP-SC
91102222	B-3, 8	0.68	<0.01	0.32	<0.01	<0.01	0.016	<5	<5	11	SC
91102224	B-3, 12	0.014	<0.01	0.16	<0.01	<0.01	<0.01	<5	<5	3.5	SP
91102229	B-4, 5.5	0.05	<0.01	0.23	<0.01	<0.01	<0.01	<5	<5	15	CH
9102231	B-4, 10	0.66	<0.05	1.1	<0.05	<0.05	<0.05	<5	<5	5.3	GP-GC
9102233	B-4, 14	0.21	<0.01	0.15	<0.01	<0.01	<0.01	<5	<5	13	SC

- 1 Concentrations expressed in milligrams per kilogram (mg/kg).
- 2 Analyte was found in the associated blank as well as the samples.
- 3 Surrogate percent recovery for bromochloromethane is out of acceptable limits.
- 4 NA: Not Analyzed
- 5 Refer to key to Unified Soil Classification System for explanation (Appendix A).

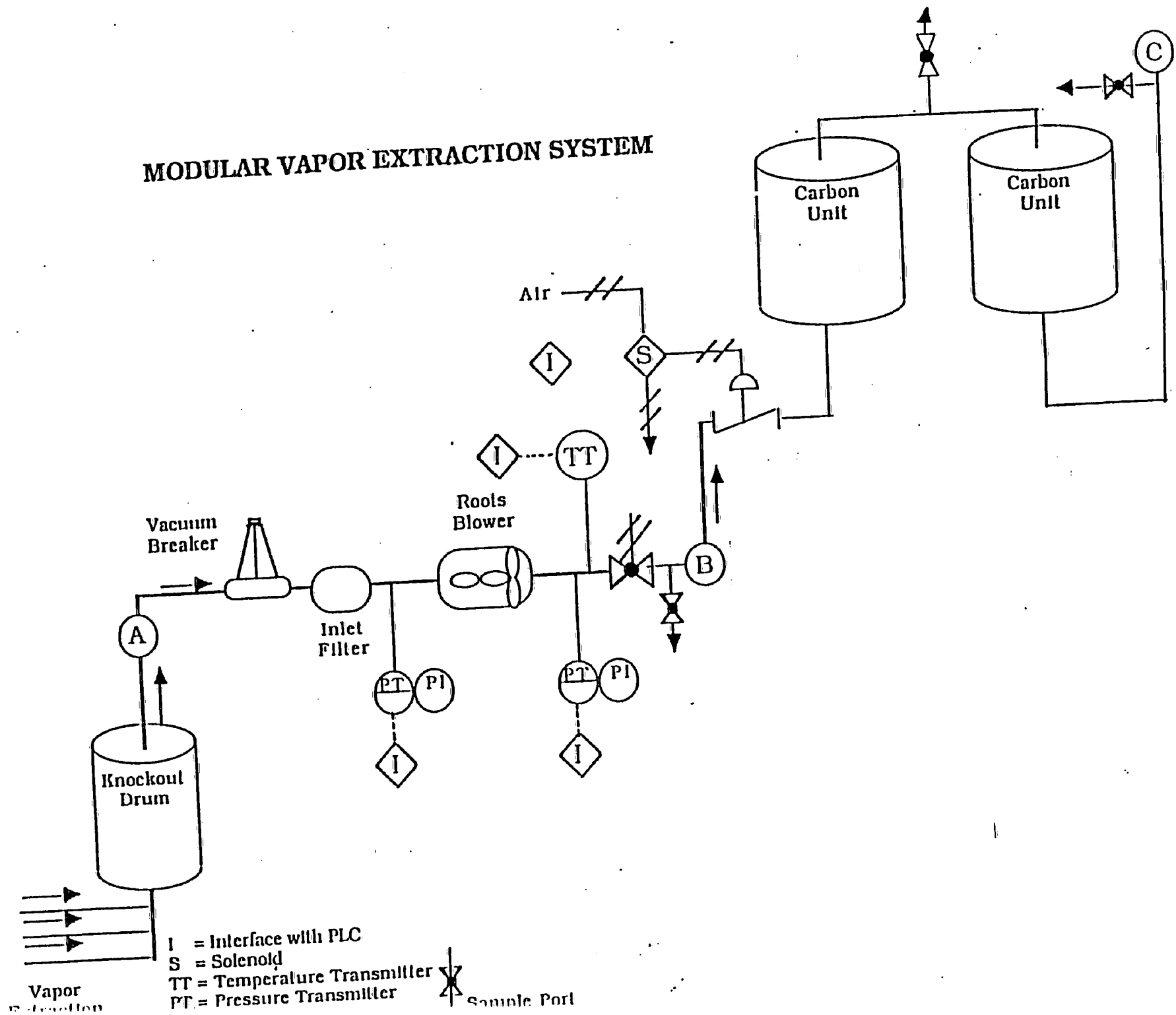
APPENDIX D
TIME VERSUS CONCENTRATION GRAPHS; SPOKANE, WA

VAPOR EXTRACTION PERCHLOROETHYLENE



APPENDIX E
MODULAR VES FLOW DIAGRAM

MODULAR VAPOR EXTRACTION SYSTEM



APPENDIX F
HEALTH AND SAFETY PLAN

Appendix

SITE SAFETY PLAN
VAN WATERS & ROGERS, INC.
BOISE, IDAHO

HLA Job No. 09695,337.02

Harding Lawson Associates
7655 Redwood Boulevard
P.O. Box 578
Novato, California 94948
415/892-0821

November 11, 1991

Harding Lawson Associates (HLA)
SITE SAFETY PLAN

This Site Safety Plan is specifically prepared for:

Project Location Former VW&R Facility, Boise, Idaho

Job Number 09695.337.02

ALL PERSONNEL PARTICIPATING IN THE FIELD MUST BE TRAINED IN THE GENERAL AND SPECIFIC HAZARDS UNIQUE TO THE JOB AND, IF APPLICABLE, MEET RECOMMENDED MEDICAL EXAMINATION REQUIREMENTS. ALL SITE PERSONNEL AND VISITORS SHALL FOLLOW THE GUIDELINES, RULES, AND PROCEDURES CONTAINED IN THIS SAFETY PLAN. THE PROJECT MANAGER OR SITE SAFETY OFFICER MAY IMPOSE ANY OTHER PROCEDURES OR PROHIBITIONS THAT THEY BELIEVE ARE NECESSARY FOR SAFE OPERATIONS.

THIS PLAN IS PREPARED TO INFORM ALL FIELD PERSONNEL, INCLUDING HLA CONTRACTORS AND HLA SUBCONTRACTORS, OF THE POTENTIAL HAZARDS ON THE SITE. HOWEVER, EACH CONTRACTOR OR SUBCONTRACTOR MUST ASSUME DIRECT RESPONSIBILITY FOR HIS OWN EMPLOYEES' HEALTH AND SAFETY.

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II PERSONS RESPONSIBLE AND INVOLVED	2
III FACILITY BACKGROUND.....	3
IV SITE CHEMICAL CONTAMINANTS.....	5
V GENERAL WORK PRACTICES.....	7
VI SITE CONTROL/WORK ZONES.....	8
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Plate 1 - Site Map	
Plate 2 - Site Location and Hospital Route Map	
Plate 3 - Generic Site Control Zones	

I. INTRODUCTIONA. SITE LOCATION: 140 N. Milwaukee, Boise, Idaho

B. — PLAN PREPARED:

S. Michelle Watson
Name
(S. Michelle Watson)11/12/91
Date

C. PLAN APPROVED:

[Signature]
Project Manager
(Christopher R. Smith)

Date

James Slattery
DHSO
(James Slattery, CSP)11/12/91
Date

D. PLAN REVISED:

Name

Date

E. REVISION APPROVED:

Project Manager

Date

DHSO

Date

F. THE POSSIBLE HAZARDS ON THIS JOB ARE EXPECTED TO BE: Contact with
contaminated soil or groundwater. Exposure to heavy equipment.G. REQUIRED PERSONAL PROTECTIVE ITEMS AND EQUIPMENT FOR THIS PROJECT:
Level D, Level C, or Level B, depending on results of air monitoring.

II. PERSONS RESPONSIBLE AND INVOLVED

- A. PROJECT MANAGER Christopher R. Smith
Health and Safety Responsibilities Responsible for ensuring all project tasks and personnel comply with applicable regulations as defined in this site safety plan.
- B. SITE SUPERVISOR To be announced
Health and Safety Responsibilities Responsible for ensuring all provisions of the site safety plan are fully implemented as project tasks are performed.
- C. SITE SAFETY OFFICER To be announced
Health and Safety Responsibilities Assist project manager/site supervisor in the selection and implementation of proper controls to minimize hazard exposure to personnel, work site, and adjacent sites.
- D. OTHERS _____
Health and Safety Responsibilities _____
- E. SUBCONTRACTORS Soil gas survey firm
Health and Safety Responsibilities All subcontractors will be responsible for maintaining the safety procedures as outlined in this site safety plan.

III. FACILITY BACKGROUND

- A. FACILITY BACKGROUND AND DESCRIPTION: Van Water and Rogers Inc. (VW&R)
formerly operated a chemical distribution facility at the site from 1972 through 1982.
VW&R operated from a warehouse shared with and subleased from Allied Van Lines.
The warehouse structure has been razed and a Pier 1 Imports store with a large paved
parking area now occupies the site.
- B. SITE HISTORY (USE OF SITE, ORIGIN OF CONTAMINATION): During recent
development in the area (Boise Towne Mall, Target Shopping Center, etc.),
perchloroethylene (PCE) was discovered in the groundwater. The horizontal and
vertical extent of contamination and a definitive source have not been identified.
- C. HAZARDOUS INCIDENT HISTORY (HISTORY OF INJURIES, EXPOSURE, CHEMICAL
SPILLS, COMPLAINTS, ETC.): PCE has been detected in downgradient
drinking water wells. A pump and treat system is currently operational near the center
of the PCE plume.
- D. PURPOSE OF ACTIVITY/OBJECTIVE OF HLA'S WORK (CHARACTERIZATION,
REMEDIAL ACTIONS, EXCAVATION, TRENCHING; INCLUDE LOCATION WITH
RESPECT TO AREAS OF KNOWN OR SUSPECTED CONTAMINATION):
A soil vapor extraction system (VES) will be installed at the site.
- E. SITE STATUS (ACTIVE, INACTIVE, UNKNOWN): Active
- F. SURROUNDINGS (LOCATION WITH RESPECT TO CITY, ROADS, RESIDENCES,
BUSINESSES, NATURAL FEATURES, GRADIENTS, TANKS, ETC.): The site is
bordered by Highway 84 to the east. Union Pacific Railroad and Franklin Road to the
south, the Boise Towne Mall parking area to the north, and Odeon Cinemas and
Milwaukee Road to the west.
- G. SITE MAP (ATTACHED MAP AT END OF THIS PLAN SHOWING SALIENT FEATURES,
INCLUDING LOCATION OF HLA'S WORK AND LOCATION OF CONTAMINATED
AREAS).

H. CLIMATE

AVERAGE WIND SPEED AND DIRECTION: _____

	July	October	January	April
MEAN HIGH TEMPERATURE	_____	_____	_____	_____
MEAN LOW TEMPERATURE	_____	_____	_____	_____

IV. IDENTIFIED CHEMICAL CONTAMINANTS

A. IDENTIFIED CHEMICAL CONTAMINANTS KNOWN TO BE PRESENT

List chemical contaminants that have been identified, their concentration, and the environmental media in which they are present. Hazardous property information for selected chemicals appears in the appendix. Review this information for all chemicals listed below. If chemicals are not listed in the appendix, you must enter the hazardous property information in the appendix in the spaces provided.

Chemical	Environmental Media (Enter Code)	Measured Concentration	
		Minimum	Maximum
PCE	GW	6.1 µg/l	5,100 µg/l
1,2 DCE	GW	ND	63 µg/l
TCE	GW	ND	70 µg/l
PCE	So	0.014 mg/kg	26,000 mg/kg
cis- 1,2 DCE	So	ND	1.3 mg/kg
methylene chloride	So	0.16	0.75 mg/kg
TCE	So	ND	3.1 mg/kg
Carbon Tetrachloride	So	ND	0.18 mg/kg

B. SUSPECTED CHEMICAL CONTAMINANTS ON SITE

List chemical contaminants that are suspected to be present.

Chemical	Environmental Media
PCE	So, GW
TCE	So, GW

Code for environmental media:

Sl	Sludge
GW	Groundwater
SW	Surface water
LW	Liquid waste
So	Soil
A	Air
Other -	Specify

C. CHEMICAL CONTAMINANTS CHARACTERIZATION

Has the site been adequately characterized to the best of your knowledge?

Yes X No

If yes, list applicable references or previous reports/studies.

Harding Lawson Associates, 1991. Soil Gas and Groundwater Investigation.
Former VW&R Facility, Boise, Idaho. October 25.

V. GENERAL WORK PRACTICES

- o No one will be permitted to engage in work operations alone.
- o Smoking, eating, drinking, chewing gum or tobacco will not be permitted within the work zones.
- o Personnel should keep track of weather conditions and wind direction to the extent they could affect potential exposure.
- o Personnel should be alert to any abnormal behavior on the part of other workers that might indicate distress, disorientation, or other ill effects.
- o Personnel should never ignore symptoms which could indicate potential exposure to chemical contaminants. These should be immediately reported to their supervisor or the Site Safety Officer.
- o No one will be allowed on site unless first cleared through Site Safety Officer.
- o Sufficient illumination will be provided at all times during night operations.

VI. SITE CONTROL/WORK ZONES

- A. DESCRIBE LOCATION OF EXCLUSION ZONE, HOT LINE, CONTAMINATION REDUCTION ZONE, AND DECONTAMINATION AREA AND SUPPORT ZONE. SHOW LOCATIONS ON SITE PLAN.

The exclusion zone, CRZ, and decontamination/support zone will be delineated with flagging and will move depending on trenching location and the results of air monitoring.

- B. DEFINE THE SITE CONTROL/SECURITY MEASURES (I.E., FENCING, LOCKED GATES, KEYS, SECURITY GUARDS, FLAGGING, ETC.)

Access to the former VW&R facility will be controlled by the Site Safety Officer and/or Project Manager during normal night trenching operations. Cyclone fencing or some other adequate physical barrier will be used to restrict access beyond the contamination control line. Access control points such as gates in the cyclone fencing, will be used to control access from the support zone to the contamination reduction zone and from the contamination reduction zone to the exclusion zone. See Plate 3 - Generic Site Control Zones.

Access to the parking lot for Pier 1 Imports immediately adjacent to the trench site will also be restricted during the course of this project.

- C. DESCRIBE SAFETY PLAN LOCATIONS.

The site safety plan will be provided to onsite personnel including (but not limited to) the project manager, subcontractors, and client.

VIII. HAZARD ANALYSES

List all activities in the Job Activity Column and assign a number to each activity (example: 1. Ground Water Sampling)

Identify how each category of hazard exists at each activity. See example hazard analyses in Appendix 2.

[illegible]

IX. HAZARD MITIGATION

Identify procedures to mitigate all hazards listed in Section VI by placing the task number next to the appropriate mitigating measure. Listing of standard procedures is not inclusive. A specific procedure must be entered to mitigate each hazard identified in Section VI.

Activity

List NumberA. Mechanical Hazards

- 1.2 Do not stand near backhoe buckets and earthmoving equipment.
 1.2 Verify that all equipment is in good condition.
 1.2 Do not stand or walk under elevated loads or ladders.
 1.2 Do not stand near unguarded excavation and trenches.
 1 DO NOT ENTER EXCAVATION OR TRENCHES OVER 5 FEET DEEP
 THAT ARE NOT PROPERLY GUARDED, SHORED, OR SLOPED!!
 1.2 Consult DHSO if other mechanical hazards exist.

B. Electrical Hazards

- 1 Locate and mark buried utilities before trenching.
 Utilities located by: _____ on _____
 1 Maintain at least 10-foot clearance from overhead power lines.
 1 Contact utility company for minimum clearance from high voltage power lines.
 1 If unavoidably close to buried or overhead power lines, have power turned off, with circuit breaker locked and tagged.
 1.2 Properly ground all electrical equipment.
 1.2 Avoid standing in water when operating electrical equipment.
 1.2 If equipment must be connected by splicing wires, make sure all connections are properly taped.
 1.2 Be familiar with specific operating instructions for each piece of equipment.

C. Chemical Hazards

- 1.2 Use personal protective equipment indicated in Section 18.
 1.2 Conduct direct reading air monitoring to evaluate respiratory and explosion hazards.
 1.2 Consult DHSO for personal air monitoring.

NE = NOT EXPECTED

D. Temperature Hazards1. Heat Stress

NE

When temperature exceeds 70°F, take frequent breaks in shaded area. Unzip or remove coveralls during breaks. Have cool water or electrolyte replenishment solution available. Drink small amounts frequently to avoid dehydration. Count the pulse rate for 30 seconds as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute at the beginning of the rest period, shorten the work cycle by one-third.

2. Cold Stress

1.2

Wear multilayer cold weather outfits. The outer layer should be of wind resistant fabric.

1.2

0° to -30°F total work time is 4 hours. Alternate 1 hour in and 1 hour out of the low-temperature area. Below -30°F, consult industrial hygienist.

1.2

Drink warm fluid. Provide warm shelter for resting. Use buddy system. Avoid heavy sweating.

E. Acoustical Hazards

1.2

Use earplugs or earmuffs when noise level prevents conversation in normal voice at distance of 3 feet.

F. O₂ Deficiency - Confined Space Hazards

Confined spaces include trenches, pits, sumps, elevator shafts, tunnels, or any other area where circulation of fresh air is restricted or ability to readily escape from the area is restricted. Consult DHSO and Corporate Health and Safety Policy prior to entering confined space.

1

Obtain permit for confined space entry

1

Monitor O₂ and organic vapors before entering. If following values are exceeded, do not enter:

- O₂ less than 19.5 percent or greater than 23%.
- Total hydrocarbons greater than 5 ppm above background, if all air contaminants have not been identified.
- Concentrations of specific contaminants exceeding action level in Section 19 if all air contaminants are identified.

NE = NOT EXPECTED

1 _____ Monitor O₂ and organic vapors continuously while inside confined space. If values cited in Item 1 are exceeded, evacuate immediately. Record instrument readings.

1 _____ At least one person must be on standby outside the confined space who is capable of pulling workers from confined space in an emergency.

1 _____ Use portable fans or blowers to introduce fresh air to confined spaces whenever use of respirator is required.

1 _____ Work involving the use of flame, arc, spark, or other source of ignition is prohibited within a confined space.

G. Radiation Hazards - Not Expected

H. Biohazards - Not Expected

I. Illumination Hazards

Lack of sufficient illumination is a concern whenever night operations are performed. Portable light stands will be used to supply ample illumination during all operations performed at night. The number of light sources and their height above the ground will be determined by the Site Safety Officer and Project Manager as work progresses. The definition of ample lighting will vary depending on the nature and precision of the work being performed.

1.2 _____ Sufficient illumination to be provided at all night operations. Minimum of 100 foot candles at the work surface is recommended.

X. AIR MONITORING

Air monitoring should be conducted with instruments selected to measure contaminants that employees may be exposed to. Measurements should be taken within the breathing zones of workers. If action levels are reached for a 1-minute reading, appropriate action must occur.

AIR MONITORING.

A. Protection Levels

1. Unknown Contaminants

For unknown contaminants, the following levels of protection should be utilized:

Breathing zone HNu/OVA
Reading for 1 minute

Background	Level D
>0-5 ppm above background	Level C
5-500 ppm above background	Level B
500-1000 ppm above background	Level A

2. Known Contaminants

PPE level changes for VOCs will be determined by measuring airborne concentrations in the operator breathing zone for a minimum of one (1) minute. Levels must be maintained at this level or higher for a minimum of one minute to justify an upgrade in PPE. Recommended actions are based on the worst case assumption that all VOCs detected are perchloroethylene.

Action Level Above Background (Breathing Zone)	Action
<1 ppm	Level D, no respirator
2 ppm	Use Draeger Detection Tube* to determine presence of perchloroethylene (PCE). If no PCE detected, remain at Level D with no respirator. If PCE found at 2 to 25 ppm, don respirator with organic vapor cartridges. If PCE is between 25 and 250 ppm, upgrade to fullface supplied air respirator. If PCE is found at concentrations greater than 250 ppm, contact DHSO.

* Use Draeger Detection Tubes for perchloroethylene, Draeger Reference Nos. 800-01501 (for 2 to 300 ppm) or 800-30701 (for 10 to 500 ppm).

Instrument & Date of Calibration	Calibration Gas Standard	Frequency/ Duration of Air Monitoring	Action Level (a)(b) Above Background (Breathing Zone)	Action
OVA _____	Methane _____	Continuous	1 ppm for 1 minute duration	Introduce engineering controls (i.e., blower fans) (Level D)
OVA _____ Draeger Pump _____	Methane _____ _____	Continuous Refer to Table A-2	1 to 25 ppm PCE _____	Don respirator (Level C)
OVA _____ _____	Methane _____ _____	Continuous _____	25 to 250 ppm PCE _____	Leave area (Level C)

Refer to Table A-2. If PCE is found at concentrations greater than 250 ppm, contact DHSO.

3. Area Monitoring

Air sampling will be performed at the perimeter of the work site, between the excavation site and the closest two corners of the Pier 1 building. An OVM and a Draeger pump with PCE detection tubes will be used for real-time monitoring. At routine intervals, the Site Safety Officer or a designee will sample the air using the OVM. If the OVM indicates no organic vapors in the air, work will proceed as usual. If the OVM detects organic vapors, a Draeger pump with PCE detection tubes will be used to screen for the presence of PCE. If the Draeger tubes indicate measurable concentrations of PCE, the Site Safety Officer may decide to implement emergency procedures as outlined in Section XIV Contingency/Emergency Information.

Perchloroethylene Standards

Federal OSHA

100 ppm
200 ppm ceiling
300 ppm for 5 minutes
once every 3 hours-peak

NIOSH

Lowest feasible
limit

ACGIH

50 ppm

- B. EXPLOSION HAZARD - Not Expected
- C. OXYGEN DEFICIENCY - Not Expected
- D. OTHER INSTRUMENTS

Instrument & Date of Calibration	Action Level (Breathing Zone/ Ambient Air)	Duration/Frequency of Air Monitoring	Action
<u>Date</u>			
<u>Draeger pump/tubes</u>	<u>1 to 25 ppm of</u>	<u>When OVA reads</u>	<u>1 to 25 ppm</u>
<u>Perchloroethylene*</u>	<u>perchloroethylene</u>	<u>1 ppm</u>	<u>PCE use</u>
	<u>(PCE)</u>		<u>respirator with</u>
			<u>organic vapor</u>
			<u>cartridges. 25</u>
			<u>to 250 ppm.</u>
			<u>upgrade to</u>
			<u>supplied air</u>
			<u>respirator.</u>

* Use Draeger Nos. 800-01501 (for 2 to 300 ppm) or 800-30701 (for 10 to 500 ppm).

LEVEL: A B X C D

<u>Head</u>		<u>Eye/Face</u>	
<u>All</u>	Hardhat	<u>All</u>	Safety Glasses _____ Faceshield Chemical Goggles

Hand
All Neoprene _____ Nitrile _____ PVC _____
Viton _____ Underglove _____ Other = _____

_____ Full Encapsulating Suit _____
 _____ Two Piece Rainsuit, Material = _____
 _____ One Piece Splash Suit, Material = _____
 _____ Hooded Tyvek Suit _____
All _____ Hooded Tyvek/Saranax Suit _____
 _____ Hooded Tyvek/Polyethylene Suit _____
 _____ Cloth Coveralls _____
 _____ High Visibility Vest _____
 _____ Other _____

_____ SCBA (open circuit, pressure demand): _____
 _____ Full Face Respirator, cartridge = _____
 _____ Supplied Air, Airline _____
 All* _____ Half Mask Respirator, cartridge = organic vapor/HEPA
 _____ Other _____

Earplug, type = foam, as needed
Earmuff, type = _____

Foot
All _____ Steel-toed Boots, type = Neoprene or work boots with covers
Disposable Overboots, type = _____

D 20679-H

Other Safety Equipment

<u>As needed</u>	Ventilation blower/fan		Lifeline harness
<u>As needed</u>	Traffic cones		Radiation Dosimeter
<u>As needed</u>	Barrier tape		
	Blast alarm		
	Ground fault circuit interrupter		

Comments: _____

XII. DECONTAMINATION PROCEDURES

- A. EQUIPMENT (SAMPLING, CONSTRUCTION, ETC.) DECONTAMINATION (SOLVENTS USED, EQUIPMENT USED, METHOD OF DISPOSAL). ATTACH SITE DECONTAMINATION MAP AS NECESSARY.

Equipment is to be decontaminated with a steam cleaner or with a low-phosphorous soap solution and rinsed with water.

- B. PERSONNEL DECONTAMINATION (SOLVENTS USED, METHOD OF SOLVENT DISPOSAL; INCLUDE DECONTAMINATION METHOD OF PPE AND DISPOSAL OF PPE). ATTACH DECONTAMINATION MAP AS NECESSARY.

Gloves and Tyveks are to be removed and disposed at the end of the shift. Respirators are to be sanitized nightly. Boots should be scraped clean and washed with Labtone soap as needed. Hands should be washed with soap and water at every break.

- C. INVESTIGATION-DERIVED MATERIAL DISPOSAL

1. Drill cuttings/well water: Excavated material should be stored on site and covered with sheets of Visqueen plastic to reduce organic vapor emissions, and to reduce wind dispersal of contaminated soil. The material should be disposed of properly based on analytical results.
2. Decontamination solutions: Fluids contained in 55-gallon drums and disposed pending receipt of analytical results.
3. Other: Used PPE will be contained in 55-gallon drums and disposed of properly.

XIII. DOCUMENTATION

HLA PERSONNEL TRAINING AND MEDICAL RECORDS ARE AT HLA NOVATO. RECORDS WILL BE MAINTAINED ON SITE AS NECESSARY.

A. PROJECT PERSONNEL LIST AND SAFETY PLAN DISTRIBUTION RECORD

1. HLA Employees

All project staff must sign, indicating they have read and understand the Site Safety Plan. A copy of this Site Safety Plan must be made available for their review and readily available at the job site.

<u>Employee Name/Job Title</u>	<u>Date Distributed</u>	<u>Signature</u>

2. Contractors, Subcontractors

A copy of this safety plan shall be provided to contractors and subcontractors who may be affected by activities covered under the scope of this Site Safety Plan. All contractors and subcontractors must comply with applicable OSHA, EPA, and local government rules and regulations.

<u>Firm Name</u>	<u>Contact Person</u>	<u>Date Distributed</u>

- B. HEALTH AND SAFETY MEETING - ALL PERSONNEL PARTICIPATING IN THE PROJECT MUST RECEIVE INITIAL HEALTH AND SAFETY ORIENTATION. THEREAFTER, A BRIEF TAILGATE SAFETY MEETING IS REQUIRED AS DEEMED NECESSARY BY THE SITE SAFETY OFFICER (OR AT LEAST ONCE EVERY 10 WORKING DAYS).

[illegible]

- C. VISITOR - IT IS HLA'S POLICY THAT VISITORS MUST FURNISH HIS/HER OWN PERSONAL PROTECTIVE EQUIPMENT. ALL VISITORS ARE REQUIRED TO SIGN THE VISITOR LOG AND COMPLY WITH THE SAFETY PLAN REQUIREMENTS. IF THE VISITOR REPRESENTS A REGULATORY AGENCY CONCERNED WITH SITE HEALTH AND SAFETY ISSUES, THE SITE SAFETY OFFICER SHALL ALSO IMMEDIATELY NOTIFY DHSO.

VISITOR LOG

[illegible]

XIV. CONTINGENCY/EMERGENCY INFORMATION

A. REQUIRED EMERGENCY EQUIPMENT LOCATION

Safety shower/eyewash: _____

First aid kit: In mall/in vehiclesFire extinguisher: In vehicles

Other: _____

B. EMERGENCY TELEPHONE NUMBERS

Ambulance: _____

911

Police: _____

911

Fire department: _____

911

Hospital: _____

Saint Alphonsus - 378-3221

Client contact: _____

Poison Control Center: _____

(800) 233-3360

CHEMTREC: _____

(800) 424-9300

Project Manager - C. Smith

Office (415) 899-7393Home (415) 897-3981

DHSO - C. Corpuz

Office (415) 899-0821Home (415) 522-0531

C. STANDARD PROCEDURES FOR REPORTING EMERGENCIES:

When calling for assistance in an emergency situation, the following information should be provided:

1. Name of person making call
2. Telephone number at location of person making call
3. Name of person(s) exposed or injured
4. Nature of emergency
5. Actions already taken

Recipient of call should hang up first--not the caller.

D. EMERGENCY ROUTES: ATTACH MAP SHOWING ROUTE TO NEAREST HOSPITAL. DESCRIBE NARRATIVELY THE ROUTE TO THE HOSPITAL. HAS HOSPITAL BEEN CONTACTED TO DETERMINE IF THEY WILL HANDLE A CHEMICAL EXPOSURE?

Directions: Enter Business I-84 toward downtown Boise (NE). Exit Curtis Road.
Turn right (south). 2 blocks. St. Alphonsus on west side of road (right).

E. CONTINGENCY PLAN

Four types of unpredictable events may occur that would require the implementation of the Contingency Plan: fire, physical injury, chemical exposure or natural catastrophes. The Site Safety Officer will provide onsite assistance and will determine whether offsite assistance is necessary.

- 1) **Fire:** In case of fire, the Site Safety Officer or site personnel should use onsite fire extinguishers to attempt to extinguish the fire. If the fire cannot be extinguished by use of fire extinguishers located in vehicles and/or onsite, the fire department should be called and the site evacuated, as appropriate. The Site Safety Officer will direct the evacuation. The Site Safety Officer will also coordinate the fire suppression activities with the

i. Procedures During Individual Chemical Exposure

The following procedures are to be followed in the event an individual is exposed to chemicals onsite.

- o Another team member (buddy) should remove the individual from the immediate area of contamination.
- o Precautions should be taken to avoid exposure of other individuals to the chemical.
- o If the chemical is on the individual's clothing, the clothing should be removed if it is safe to do so.
- o If the chemical has contacted the skin, the skin should be washed with copious amounts of water, preferably under a shower.
- o In case of eye contact, an emergency eye wash should be used. Eyes should be washed for at least 15 minutes.
- o If necessary, the victim should be transported to the nearest hospital or medical center. If necessary, an ambulance should be called to transport the victim.
- o All chemical exposure incidents will be reported in writing by the site safety officer using the Accident Investigation Form (see attachments).

b) Large Scale Exposure

The following measures are designed to minimize the possibility of a large scale chemical release.

1. Minimal Trench Openings - In order to minimize the amount of PCE volatilized into the air, the amount of trench opening should be kept to a minimum. Previously excavated areas of the trench should be covered with traffic plates when not actively being worked on.
2. Night Operations - Because of the high visibility of this project, the proximity to a shopping center and the anticipated high volume of shoppers, all intrusive operations should be performed at night whenever possible. Some of the possible safety concerns involved with night work including cold stress and illumination considerations are addressed in Section IX, Hazard Mitigation.
3. Security Precautions - Security precautions are delineated in Section VI Site Control/Work Zones.

c) Odor Releases/Complaints

Although all feasible precautions will be taken to reduce the potential of odor releases and the resulting complaints, it is still a possibility which must be addressed.

Perchloroethylene has a not unpleasant ethereal or aromatic odor. Various human experimental studies and industrial experience indicates the following odor threshold levels:

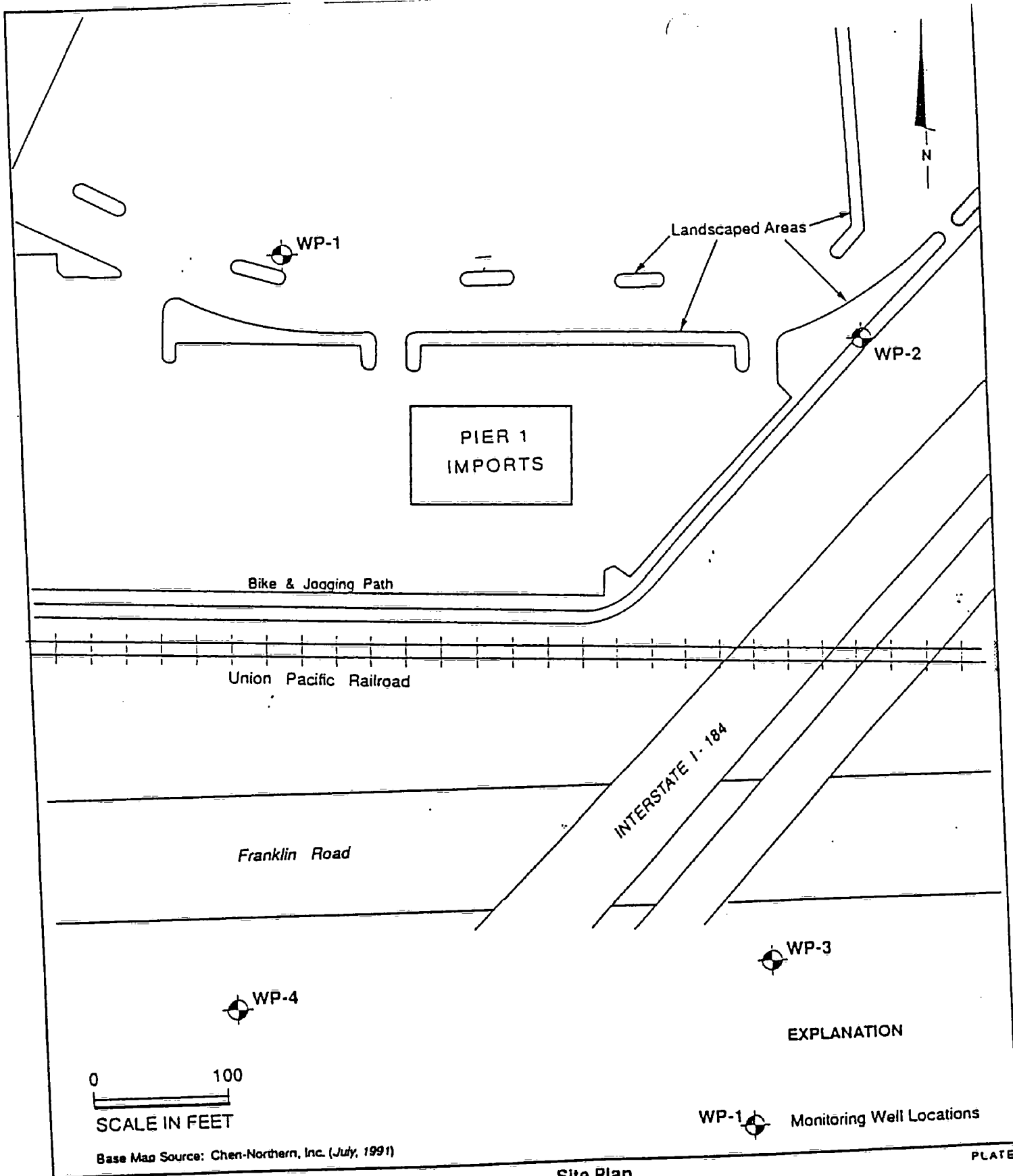
50 ppm	Odor (definite) moderate to faint upon exposure Faint to moderate eye irritation Minimal light-headedness (Eye irritation threshold 100-200 ppm)
100 ppm	Odor (strong) unpleasant Definite eye irritation, slight nasal irritation Definite incoordination (2 hr)
600 ppm	Odor (strong) very unpleasant but tolerable Definite eye and nasal irritation Dizziness, loss of inhibitions (10 min)
1000 ppm	Odor (very strong) intense, irritating Markedly irritating to eyes and respiratory tract Considerable dizziness (2 min)
1500 ppm	Odor (almost intolerable) "gagging" Irritation almost intolerable to eyes and nose Complete incoordination within minutes to unconsciousness with 30 minutes

As can be seen from the preceding table, odor complaints should not be a problem unless the air concentration levels exceed 50 ppm, which is also the ACGIH recommended TLV. If the OVM and Draeger tubes indicate measurable concentrations of PCE or if odor becomes apparent beyond the perimeter of the work boundary, the work may be temporarily stopped. Traffic plates can be used to cover the excavated sections of the trench and work may be discontinued until the odor level drops below the threshold. In all cases, the Site Safety Officer and/or Project Manager will make the decision to continue or discontinue the work. Some of the factors he/she may consider include the presence of shoppers or offsite visitors and the wind direction.

d) Addressing Media Representatives

In the event site workers are approached by news media, all personnel should be instructed to politely but firmly refuse to discuss any technical issues. Instead, they should refer the news media representatives to the senior VW&R representative onsite or the HLA Site Safety Officer.

- 4) Natural Catastrophes: In the event of flooding or similar catastrophic events, all personnel will meet outside the former VW&R site at a pre-determined rally point to assure that each onsite person is accounted for. The meeting area should be safe from falling objects or hazards associated with the catastrophe.



Base Map Source: Chen-Northern, Inc. (July, 1991)



Harding Lawson Associates
Engineering and
Environmental Services

Site Plan
Health and Safety Plan
Van Waters & Rogers Boise
Boise, Idaho

DRAWN **CNc** JOB NUMBER **9695,335.02**

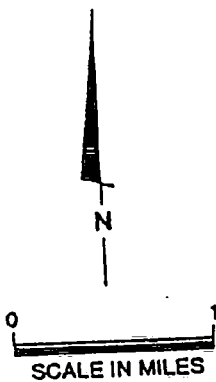
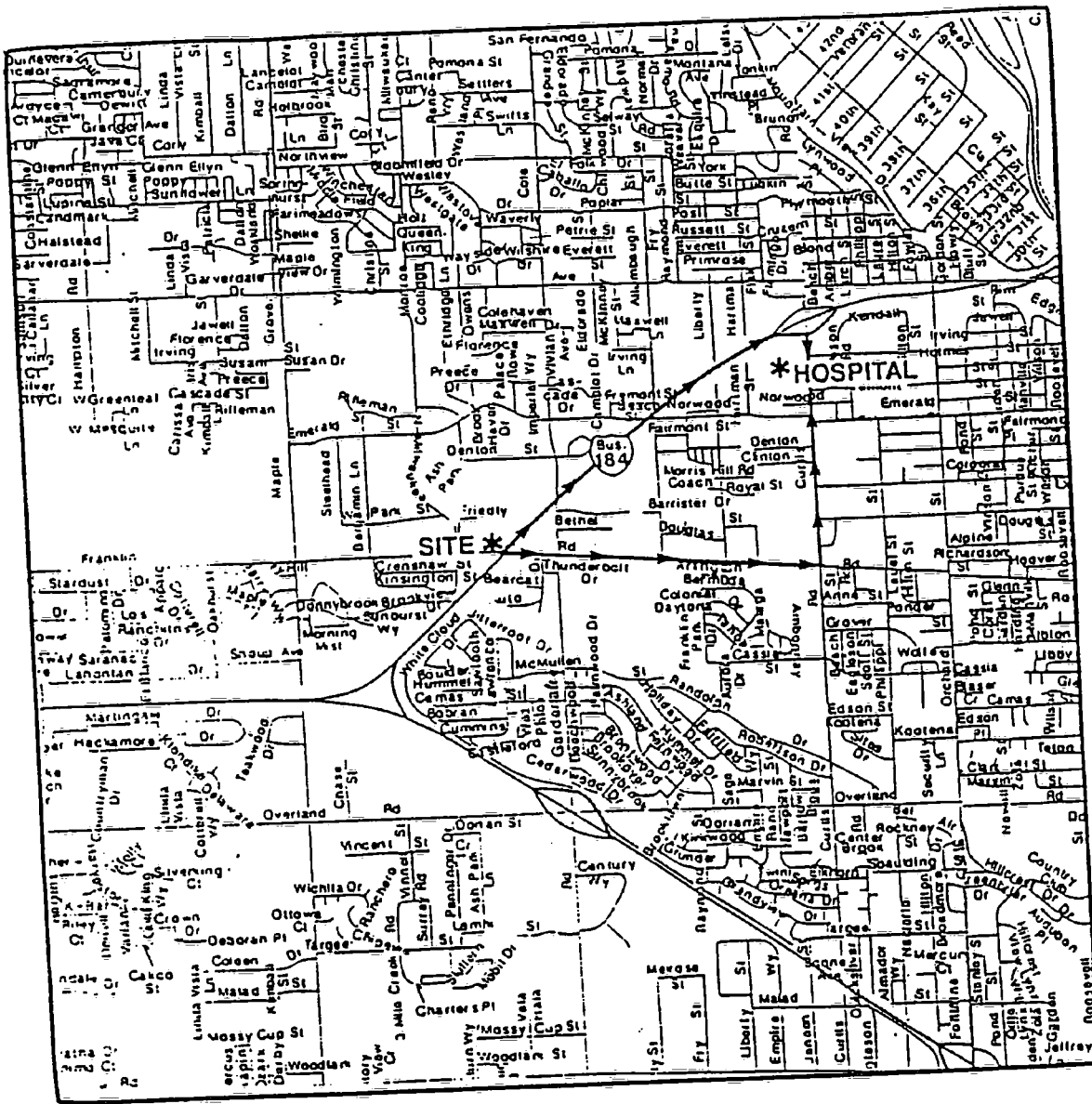
APPROVED *SMW*

DATE **8/91**

REVISED DATE

PLATE

1



Harding Lawson Associates
Engineering and
Environmental Services

Site Location and Hospital Routes
Health and Safety Plan
Van Waters and Rogers Boise
Boise, Idaho

DRAWN
CSN

JOB NUMBER
9695,335.02

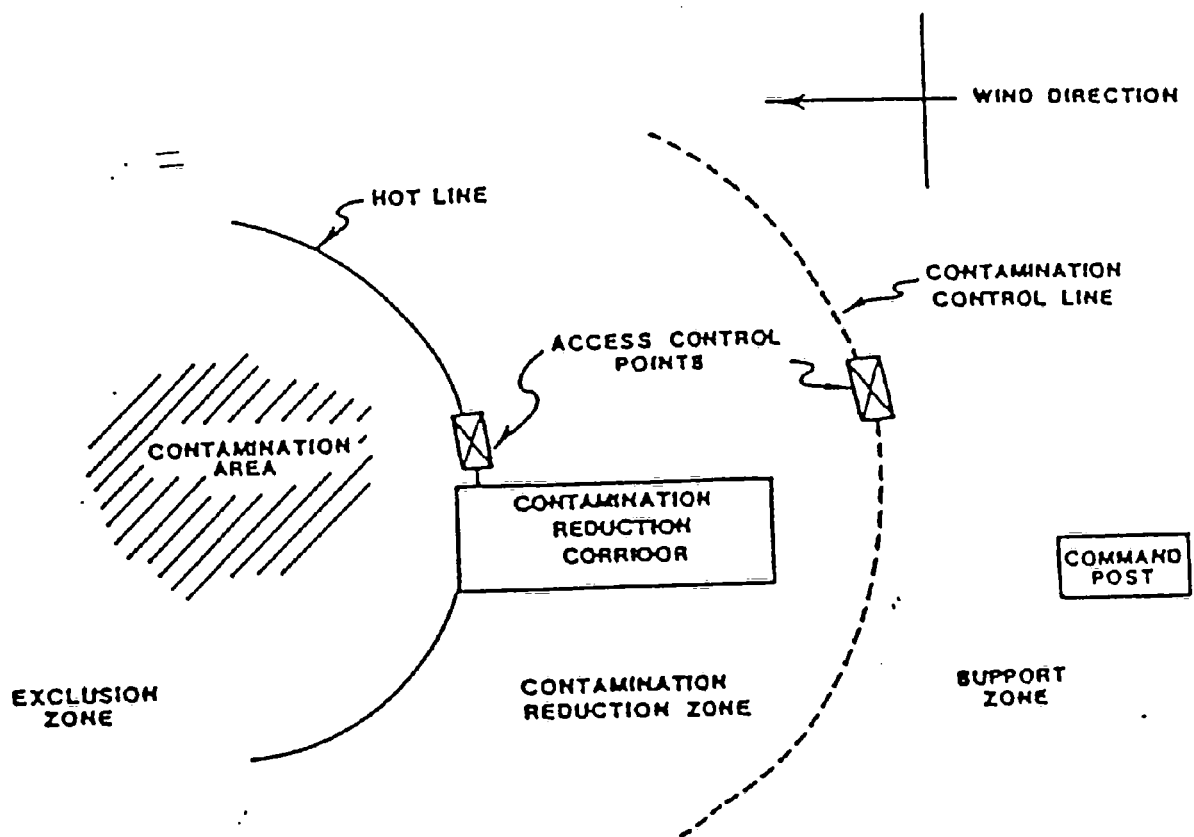
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8/91

REVISED DATE

PLATE

2



GENERIC SITE CONTROL ZONES

Reference: EPA, 1984a.



Harding Lawson Associates
Engineers and Geoscientists

Generic Site Control Zones
Health and Safety Plan
Van Waters and Rogers Boise
Boise, Idaho

PLATE

3

DRAWN
EH

JOB NUMBER
9695,335.02

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8/91

REVISED

DATE

Appendix A

HAZARDOUS PROPERTY INFORMATION

This appendix contains hazardous property information for selected compounds. Place a check mark next to each compound identified in Section IV, and review the hazardous property information for those compounds. If you have identified compounds in Section IV that are not listed in the appendix, you must list the compounds and enter the appropriate information.

(INCLUDE COPIES OF MATERIAL SAFETY DATA SHEETS FOR SELECTED COMPOUNDS IN ADDITION TO COMPLETION OF APPENDIX 1.)

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility ^a	Specific Gravity	Vapor Density	Flash Point F	Vapor Pressure ^a	LEL UEL	LD50 mg/kg	TLV-TWA ^g	IDLH Level	Odor Threshold or Warning Concentration	Hazard Property	Dermal Toxicity ^k	Acute Exposure Symptoms
VOLATILE ORGANIC PRIORITY POLLUTANTS														
	Acrolein	22%	0.8410	1.9	-15	2.8% 214 mm	31%	46	0.1 ppm	0.1-16.6 5 ppm	BCED (0.21-0.5)	BJ	ABDFGHIKLMNO PQR	
	Acrylonitrile	7.1%	0.8060	1.8	30	83 mm 17%	3%	82	2 ppm	4,000 ppm	19-100	BCEGO	DIG	FGIKLMNOR
	Benzene	820 ppm	0.8765	2.8	12	75 mm 7/1%	0.339%	3800	1 ppm	2,000 ppm	4.68	BCGO	CIG R	BCDFHIKLMNOQ
	Bromomethane	0.1 g	1.732	3.3	none	1.88 atm 14.5%	13.5% ^c		5 ppmh	2,000 ppm	no odor	CD	R	BCDEIJKLMNOQ
	Bromodichloromethane	Insoluble	1.980	-	none	n/a flam	non	916 established	none	none specified		CGO		BIMN
	Bromoform	0.01g	2.887	-	none	5 mm flam	non	1147	0.5 ppm	n/a	530	CED		BCDKLM
	Carbon Tetrachloride	0.08%	1.5967	5.3	none	91 mm flam	non	2800	5 ppmh	300 ppm	21.4-200	CD	JGH	ABCFGHKMO
	Chlorobenzene	0.01 g	1.1058	3.9	84	8.8 mm 8.6%	1.3%	2910	75 ppm	2,400 ppm	0.21-60	BCD	CIF	BCFIKLMNOPQR
	Chloroethane	0.6 g	0.8978	2.2	-58	1.36 atm 15.4%	3.8%		1000 ppm	20,000 ppm		BCD		BFHIKMNP
	2-Chloroethylvinyl Ether	Insoluble	1.0475	3.7	80	30 mm	-	250 established	none	none specified		BCD		NIM
	Chloroform	0.8 g	1.4832	4.12	none	160 mm flam	non	800	10 ppmh	1,000 ppm fatigue (>4096)	50-307	CD		BCDGIKLMN
	Chloromethane	0.74%	0.9159	1.8	32	50 atm 19%	7.6%		50 ppmh	10,000 ppm no odor (500-1000)	10-100	BCD	DHF OR	ABCDEFGHIJKLO
	Dibromochloromethane	Insoluble	2.451	-	-	-	-	848 established	none	none specified		BCD		BFHIMNPQ
	1,1-Dichloroethane (DCA)	0.1 g	1.1757	8.4	22	182 mm 16%	6%	725	100 ppm	4,000 ppm	5 ppm	BCD		AGHIMNO

HAZARDOUS PROPERTY INFORMATION

Check if present	Material	Water Solubility ^a	Specific Gravity	Vapor Density	Flash Point F	Vapor Pressure ^e	LEL UEL	LD50 mg/kg	TLV-TWA ^g	IDLH Level	Odor Threshold or Warning Concentration	Hazard Property	Dermal ^k Toxicity	Acute ^l Exposure Symptoms
	1,2-Dichloroethane	0.8%	1.2554	3.4	55	87 mm 16%	6.2%	670	10 ppmh	1,000 ppm	6 ppm	BCDG		BCFGOLMNQ
*	1,1-Dichloroethylene (DCE)	2250 mg/l @77°F	—	3.4	3	591 mm	7.3% 16.0%	200	5 ppmh	none specified		BCD		BIMN
	Trans-1,2-Dichloroethylene Slightly soluble		1.2565	—	36	400 mm 12.8%	8.7%	established	none	none specified	.0043 mg/l	BCD		ABFILOQ
	1,2 Dichloropropane	0.26%	1.583	3.9	60	40 mm 14.5%	3.4%	1900	75 ppm	2,000 ppm	50	BCD		ABGHIKMNO
	Cis-1,3-Dichloropropane	Insoluble	1.2	3.8	83	28 mm 14.5%	5%		1 ppmh specified	none		BCD		ABGIKLMNP
	Trans-1,3-Dichloropropane	Insoluble	1.2	3.8	83	28 mm 14.5%	5%		1 ppmh specified	none		BCD		ABGIKLMNP
	Ethylbenzene	0.015 g	0.867	3.7	59	7.1 mm 6.7%	1.0%	3500	100 ppm	2,000 ppm		BCD	CIF	ABFHIKLMNPQR
*	Methylene Chloride	Slightly soluble	1.335	2.9	none	350 mm	12% ^c unavailable	167	100 ppmh	5,000 ppm	25-320 (200)	CED	CIF	BCIKLMNPR
	1,1,2,2-Tetrachloroethane	0.19%	1.5953	5.8	none	5 mm flam	non		1 ppmh	150 ppm	3-5	CD		ABCFHIKLMNOQ
*	Tetrachloroethylene	0.15 g/ml	1.6227	5.8	none	15.8 mm flam	non	8850	50 ppmh	500 ppm (160-690)	4.68%-50	CD		ACFHIKLMNP
	1,1,1-Trichloroethane (TCA)	0.7 g	1.3390	4.6	none	100 mm	8.0% ^c 10.5%	10300	350 ppm	1,000 ppm	20-400 (500-1000)	BCED		ABEFHIKLNOP
	1,1,2-Trichloroethane	0.45	1.4397	4.6	none	19 mm 15.5%	6% ^c	1140	10 ppm	500 ppm	-0-	C	Q	DEFGHIKMN
*	Trichloroethylene (TCE)	0.1%	1.4642	4.5	90d	58 mm 80%	12.5%	4920	50 ppmh	1,000 ppm	21.4-400	BC		BFKLNOPO
	Trichlorofluoromethane	0.11 g	1.494	—	none	0.91 atm flam	non		1000 ppm	10,000 ppm	135-209	CD		BFHKLO

Material Safety Data Sheet

From Genium's Reference Collection
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PERCHLOROETHYLENE
(Revision D)
Issued: November 1978
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

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Material Name: PERCHLOROETHYLENE

Description (Origin/Uses): Used in commercial dry cleaning and metal-degreasing operations; used to a lesser extent in home products and in veterinary anthelmintics (worming).

Other Designations: Ethylene Tetrachloride; Tetrachloroethylene; C_2Cl_4 ; CAS No. 0127-18-4

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.



NFPA

HMIS

H 1

F 0

R 1

PPG*

*See sect. 8

R 1

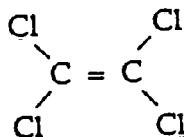
I 3

S 2

K 0

SECTION 2. INGREDIENTS AND HAZARDS

Perchloroethylene, CAS No. 0127-18-4



*See NIOSH, RTECS (No. KX3850000), for additional data with references to reproductive, irritative, tumorigenic, and mutagenic effects.

Ca 100

EXPOSURE LIMITS

OSHA PEL

8-Hr TWA: 100 ppm

Ceiling: 200 ppm

Maximum Peak above the Ceiling: 300 ppm
for 5 min. in any 3 Hrs

ACGIH TLVs, 1987-88

TLV-TWA: 50 ppm, 340 mg/m³TLV-STEL: 200 ppm, 1340 mg/m³

Toxicity Data*

Human, Inhalation, TC_{LD}: 96 ppm/7 Hrs

SECTION 3. PHYSICAL DATA

Boiling Point: 250°F (121°C)

Specific Gravity (H₂O = 1): 1.623

% Volatile by Volume: 100

Water Solubility (%): Insoluble

Molecular Weight: 166 Grams/Mole

Vapor Pressure: 19 Torrs at 77°F (25°C)

Vapor Density (Air = 1): 5.83

Appearance and Odor: A clear, colorless liquid; ethereal odor.

SECTION 4. FIRE AND EXPLOSION DATA

LOWER

UPPER

Flash Point and Method

Autoignition Temperature

Flammability Limits in Air
% by Volume

Extinguishing Media: *Perchloroethylene does not burn. Use extinguishing agents that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: Perchloroethylene vapor is heavier than air and it collects in low-lying areas such as sumps, wells, and underground piping systems. Enter these low-lying areas with appropriate caution.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Use care in selecting safety equipment (see sect. 5, Conditions to Avoid).

SECTION 5. REACTIVITY DATA

Perchloroethylene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous chemical reactions involving perchloroethylene and barium, beryllium, or lithium are reported in Genium reference 84, page 491M-208.

Conditions to Avoid: Prevent contact with incompatible chemicals. Avoid exposure to direct sunlight. Monitor the stabilizer level in the perchloroethylene product; get specifications from your supplier for the proper inhibitor levels. This material forms hydrochloric acid (HCl) if the inhibitor level becomes too low. Do not mix perchloroethylene with caustic soda or potash. This material may degrade or attack rubber and some plastics and coatings, so select protective gear and handling equipment carefully.

Hazardous Products of Decomposition: Although perchloroethylene itself does not burn, it can be very hazardous in fires because of thermooxidative degradation at high temperatures to very toxic phosgene and corrosive hydrogen chloride. Electric arcs and perchloroethylene vapor may also produce these products of hazardous decomposition.

SECTION 6. HEALTH HAZARD INFORMATION

Perchloroethylene is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Perchloroethylene affects the central nervous system (CNS), causing incoordination, headache, vertigo, light narcosis, dizziness, unconsciousness, and even death. All of these can occur as the level and duration of exposure continues.

Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** CNS, eyes, skin.
Primary Entry: Inhalation, skin. **Acute Effects:** Irritation of the skin, eyes, and upper respiratory tract (URT); CNS effects.
Chronic Effects: None reported.

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes.

Skin: Immediately wash the affected area with soap and water.

Inhalation: Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. Do not induce vomiting.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, No. U210

CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per Clean Water Act (CWA), section 307 (a) and Resource Conservation and Recovery Act (RCRA), section 3001

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of perchloroethylene solution may occur, wear a full face shield/splash guard. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Consult the *NIOSH Pocket Guide to Chemical Hazards* for general recommendations on respirator protection. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated skin contact with perchloroethylene. Suggested material includes polyvinyl alcohol, polyethylene, or neoprene. Leather shoes are also appropriate.

Ventilation: Install and operate general and local ventilation systems that are powerful enough to maintain airborne levels of perchloroethylene dust below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment.

Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Avoid inhaling perchloroethylene vapor. Select safety equipment carefully (see sect. 5, Conditions to Avoid).

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store perchloroethylene in a cool, dry, well-ventilated area away from barium, beryllium, and lithium.

Special Handling/Storage: Protect containers from physical damage. Fit all holding tanks with an air-drying venting system that prevents moist air from entering the tank and allows for perchloroethylene vapor expansion and contraction; airtight storage facilities are not recommended. Aluminum is not recommended for storage facilities.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Tetrachloroethylene

DOT ID No. UN1897

DOT Label: None

DOT Hazard Class: ORM-A

IMO Label: Saint Andrew's Cross (X)*

IMO Class: 6.1

*Harmful-Stow away from Foodstuffs (Materials of IMO Class 6.1, Packaging Group III).

References: 1, 12, 73, 84-94, 100, 103.

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Industrial Hygiene Review: DJ Wilson, CIH

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HAZARDOUS PROPERTY INFORMATION EXPLANATIONS AND FOOTNOTES

Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water, such as gasoline. However, most of these materials are water soluble at the part per million or part per billion level. Gasoline, for example, is insoluble in the gross sense, and will be found as a discreet layer on top of the groundwater. But certain gasoline constituents, such as benzene, toluene, and xylene will also be found in solution in the groundwater at the part per million of part per billion level.

- a. Water solubility expressed as 0.2 g means 0.2 grams per 100 grams water at 20°C.
- b. Solubility of metals depends on the compound in which they are present.
- c. Several chlorinated hydrocarbons exhibit no flash point in conventional sense, but will burn in presence of high energy ignition source or will form explosive mixtures at temperatures above 200°F.
- d. Practically non-flammable under standard conditions.
- e. Expressed as mm Hg under standard conditions.
- f. Explosive concentrations of airborne dust can occur in confined areas.
- g. Values for Threshold Limit Value-Time Weighted Average (TLV-TWA) are OSHA Permissible Exposure Limits except where noted in h and i.
- h. TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists, which is lower than the OSHA PEL.
- i. TLV-TWA recommended by the national Institute for Occupational Safety and Health (NIOSH). A TLV or PEL has not been adopted by ACGIH or OSHA.
- j.

A	-	corrosive
B	-	flammable
C	-	toxic
D	-	volatile
E	-	reactive
F	-	radioactive
G	-	carcinogen
H	-	infectious
- k. Dermal Toxicity data is summarized in the following three categories:

Skin Penetration

-	A	-	negligible penetration (solid-polar)
+	B	-	slight penetration (solid-nonpolar)
++	C	-	moderate penetration (liquid/solid-nonpolar)
+++	D	-	high penetration (gas/liquid-nonpolar)

Systemic Potency

E	-	slight hazard - LD ₅₀ = 500-15,000 mg/kg lethal dose for 70 kg man = 1 pint-1 quart
F	-	moderate hazard - LD ₅₀ = 50-500 mg/kg lethal dose for 70 kg man = 1 ounce-1 pint
G	-	extreme hazard - LD ₅₀ = 10-50 mg/kg lethal dose for 70 kg/man = drops to 20 ml

Local Potency

H	-	slight - reddening of skin
I	-	moderate - irritation/inflammation of skin
J	-	extreme - tissue destruction/necrosis

I. Acute Exposure Symptoms

A	-	abdominal pain
B	-	central nervous system depression
C	-	comatose
D	-	convulsions
E	-	confusion
F	-	dizziness
G	-	diarrhea
H	-	drowsiness
I	-	eye irritation
J	-	fever
K	-	headache
L	-	nausea
M	-	respiratory system irritation
N	-	skin irritation
O	-	tremors
P	-	unconsciousness
Q	-	vomiting
R	-	weakness